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Proceedings of Seminar on Geographical Referencing

SPONSORED BY

THE INTERMINISTERIAL COMMITTEE ON GEOGRAPHICAL REFERENCING

MARCH 1981

Ontario
Ministry of Natural Resources
Hon. Alan W. Pope
Minister
W. T. Foster
Deputy Minister

Interministerial Committee on Geographical Referencing

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Ministry of Community and Social Services

Ministry of Consumer and Commercial Relations

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FOREWORD

The need of positionally related data by other than the originators often necessitates costly conversion of the data to a different reference base or format. The Province has taken steps to remedy this situation. As a matter of policy the Government of Ontario has adopted the Universal Transverse Mercator (UTM) Grid System as the official standard geographical referencing grid for the Province. In addition it has embarked on a basic mapping program which will provide accurate topographic maps displaying the UTM grid. As more agencies use these maps as a reference base for their own thematic data, many of the problems and costs associated with conversion to a common base will disappear.

Once the basic mapping program was in place the Interministerial Committee on Geographical Referencing (ICOGR) was formed to provide a forum for the discussion and exchange of information on geographical referencing activities in Ontario. The Committee is studying referencing needs and developing and promoting the use of standards towards the implementation of a comprehensive geographical referencing system for the Province.

After investigating the various referencing methods used by the geographical referencing systems in the Provincial Government and Ontario Hydro, ICOGR concluded that it would be difficult, if not impossible, to transfer data between these systems without making major modifications to most of them. The Committee believed, therefore, that its efforts could be better spent on developing standards for a comprehensive geographical referencing system and promoting the adoption and use of these standards for any new geographical referencing applications and in the redev_iopment of any existing applications.

The development of a standard, comprehensive geographical referencing system does not infer the development of a single utility into

which all information is placed. It is the expectation of the Committee that those agencies with the mandate to gather, store and disseminate specific information will continue to do so. The Committee is attempting to develop geographical referencing standards and specifications which, hopefully, in time will be incorporated into many of the information systems in the Province in order to expedite the transfer and correlation of geographically referenced data.

Since holding the first geographical referencing seminar in September, 1978, the Ministry with the assistance of ICOGR has prepared specifications for and monitored the development of a pilot system for the production of digital Ontario Base Maps, Forest Resources Inventory and other related thematic maps. This involvement has provided an insight into some of the problems associated with the development of digital mapping systems, particularly when they are to form the framework for a network of land related information systems.

The Seminar presentations were chosen so as to give an overview of geographical referencing activities in the Province, gain an insight into the perceived needs of others in geographical referencing and provide a status report on the pilot project, its potential and current limitations. It is the Committee's view that seminars such as this provide an excellent communications forum, help in charting the future of geographical referencing in Ontario and foster the development of acceptable referencing standards for use by all levels of government.

The Interministerial Committee on Geographical Referencing is very grateful to the speakers for their contributions and to the delegates for their interest and participation.

R.G. Code

Robert G. Code, Chairman
Interministerial Committee
on Geographical Referencing

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WELCOME AND INTRODUCTION OF FIRST THEME SPEAKER BY ROBERT G. CODE, CHAIRMAN, INTERMINISTERIAL COMMITTEE ON GEOGRAPHICAL REFERENCING

Good morning ladies and gentlemen. My name is Robert Code and I am Chairman of the Interministerial Committee on Geographical Referencing. It is in that capacity and on behalf of that Committee that I open this meeting today.

Before introducing our first speaker, I would like to tell you something about him. His name is Bill Foster, and he is Deputy Minister of the Ontario Ministry of Natural Resources. Mr. W. T. Foster is a professional forester. Following graduation from the University of Toronto, and after working in the woods industry, he joined the Reforestation Division of the former Department of Lands and Forests in 1948. He has been in a variety of positions, Fire Control Specialist, District Forester, and then into the senior positions in forest protection and provincial air service operations. In 1971/72 he directed the implementation of organization of the Ministry of Natural Resources under the Committee on Government Productivity. Upon completion of that job, he became Assistant Deputy Minister, Southern Ontario. Last January 1st he was appointed Deputy Minister. With that background I am sure you will agree he is also a professional administrator. However some of us like to think he is still a forester at heart. Bill Foster is a person who throughout his career in the government service in Ontario has gained vast knowledge about the province we live in, and the country of which we are a part. Not only does this knowledge include the geography, but it includes a great understanding of the peoples throughout the length and breadth of Ontario, how they live, how they work and how they play.

It is my very great pleasure to introduce Mr. W. T. Foster, Deputy Minister of Natural Resources. (Applause)

MR. W. T. FOSTER
DEPUTY MINISTER OF NATURAL RESOURCES

Thanks, Mr. Chairman. Since becoming the new Deputy Minister, it is astounding to me the flattery I get from some of my old colleagues. They were never quite that generous before January 1st, for some reason. (Laughter) I'm pleased to say good morning and I'm also impressed, greatly impressed, with the numbers of delegates to this Conference and this Seminar, as I am with the diversity of representation from industry, from universities and from other provinces.

Because the Ontario Minister of Natural Resources, the Honourable James A. C. Auld, could not be with us today, I have the very pleasant responsibility of conveying to all the delegates at this Seminar, especially those from other provinces, a warm welcome from our Premier, the Honourable William G. Davis. The Government of Ontario fully recognizes the value of having a comprehensive geographical referencing system and believes this Seminar can contribute materially to that objective.

Mr. Auld has asked me, as his Deputy Minister, to express his real regret at being unable to be present to add his personal greeting, because his interest in your subject of discussion goes back a long way. He has not only been following and supporting the proceedings of the Interministerial Committee on Geographical Referencing during the time he has been Minister of Natural Resources, but was also already directly familiar with the benefits the Committee's work could secure when he first came to us as our Minister.

For the three years before coming to Natural Resources, Mr. Auld was Chairman of the Ontario Cabinet Committee, called the Management Board, and his duties there included a close analysis of the financial and administrative implications of all ministry submissions and program proposals. In that position he had done a good deal of the homework leading to the Cabinet decision made in July, 1977, that assigned to

the Minister of Natural Resources the prime responsibility for a basic mapping policy in Ontario, and maintenance of the integrity of the provincial referencing grid.

So Mr. Auld was well aware of the importance of the objective, even if he didn't foresee that in the following year he'd be carrying out the directive himself. One of his real regrets was not knowing he was coming to the Ministry a year or so before he came. I guess he feels he might have funded it a little more generously from Management Board. So that's one of his regrets.

Of course our Ministry, in its direct line of descent from the old Ontario Department of Lands and Forests, has an historic association with everything having to do with geographical referencing.

In the last century, as a matter of fact, when law enforcement and punishment was somewhat harsher than it is today, a statute was enacted to lighten some of the surveyor general's problems by making the removal or defacement of a survey post a hanging offense! That may have helped to take care of the survey posts, but it didn't do anything to prevent the proliferation of a multitude of different referencing systems.

That tangle of different systems multiplied vastly over the years. It might have grown beyond hope of logical integration had not the situation been brought to attention in the early 1970s in our Province by the Committee on Government Productivity, the Law Reform Commission, the Ontario Economic Council, and others.

As a result, in June, 1973, the Ontario Government's Cabinet Committee on Resources Development instructed our Ministry to study the problem. On February 1st, 1974, Bob Code, in his capacity as Surveyor General for Ontario, was authorized to provide the leadership necessary to develop a comprehensive geo-referencing system.

A small, active task force was recruited, mainly from within our Ministry, but we were fortunate in also obtaining the services of Dick Groot from the Department of Energy, Mines and Resources. Incidentally, he'll be serving as the chairman of this Seminar tomorrow.

That Task Force reached two firm conclusions. First, that the Universal Transverse Mercator Grid System — the UTM Grid, as you all know it — was the obvious choice as a standard referencing grid for the Province. It had been the standard of the Canadian Government for more than 30 years, and is in regular use today in more than 50 other countries. It's already used in four other provinces and Ottawa has confirmed it will remain the official grid for Federal mapping. Eighteen Ontario ministries and Ontario Hydro approved its choice. Policy makers, planners, engineers, scientists and land managers like it, and numerous municipalities, as well as some private companies have already adopted it.

The second conclusion the Task Force reached was that a basic mapping program should be undertaken to produce an orderly, systematic series of topographical base maps based on, and showing, the UTM grid.

Those two conclusions can be summarized briefly enough to sound simple, but a huge amount of confirmatory work, study, discussion and planning was necessary before detailed recommendations, backed by supporting evidence, could be submitted to the searching kind of cost-benefit analysis of Ontario's Management Board of Cabinet.

It took three years to complete the groundwork, and another year for those recommendations to be fully examined, evaluated and discussed in the Cabinet process. As I've said, Mr. Auld took his duties seriously.

In July, 1977, approval was given for the launching of a long-range program to provide basic mapping of the entire Province, based on the

UTM grid, which was to become the official standard geo-referencing grid for Ontario.

Only one roadblock stood in the way of prompt implementation. New programs need funding, and with money already tight, delays seemed likely on the mapping project. Happily, though, our good friends at the Ontario Ministry of Northern Affairs were able to tide us over the interim period out of their own budget, and we're grateful to them.

The responsibility given to our Minister to establish a comprehensive geo-referencing system for the Province also called for prompt action. Within three months, the Interministerial Committee on Geographical Referencing had been formed in September, 1977.

That Committee — which, of course, is sponsoring this Seminar — has representation from all Ontario provincial ministries engaged in mapping, and is in touch with all the major municipalities and with the commercial and professional bodies connected with cartography.

There's no question that some time will be required before use of the UTM grid can become universal in Ontario; any attempt at an overnight change would have brought chaos. But, in my view, there's also no question that it's an objective to be achieved as rapidly as possible. It has to be pursued whenever an opportunity presents itself to do so in an orderly manner.

I won't attempt to summarize all the advantages of the UTM grid in this brief talk. Some of them are self-evident, others are more complex. Most of you are already familiar with them in any case, and for anyone who isn't, advance copies of a publication on the subject are available here today.

Many of you are also probably aware that good progress is being made with the Ontario Basic Mapping program. It will take some 13 years

to complete comprehensive coverage of the Province, and thereafter the necessary updating process will provide a virtually continuous operation.

Our Ministry co-ordinates and monitors the program, but the major share of the work is being undertaken by the private sector.

We believe that the Ontario Basic Mapping program is going to save money. It is allowing us to be at the leading edge of the research and development in automated cartographic technology, and through our program with Dr. Jim Linders at the University of Guelph, to develop some of that technology ourselves. It's enabling us to provide a steady volume of domestic business to highly skilled craftspeople who are already making a remarkable contribution to Ontario's exports.

We are extremely pleased to see this Seminar so well attended and I understand a wide-ranging and interesting program has been prepared to provide two productive days which I'm sure you will find worthwhile. I want to congratulate the Interministerial Committee on the arrangements it has made for this occasion, and in addition, to thank the Committee very sincerely for the dedicated hard work that has gone into its sessions since its inauguration.

And concluding, speaking on Mr. Auld's behalf as well as my own, I want to wish this Seminar the greatest success. Thank you very much. (Applause)

GENERAL CHAIRMAN ROBERT CODE: Thank you very much Mr. Foster. If there was previously any doubt about us having a grid there should be none now!

MR. ROBERT G. CODE, CHAIRMAN,
INTERMINISTERIAL COMMITTEE ON GEOGRAPHICAL REFERENCING

Before moving along into the program I would like to give an explanation of two terms that I shall use. Term #1 is ICOGR. It refers to the committee sponsoring this Seminar, the Interministerial Committee on Geographical Referencing. It meets regularly; it makes important reports now and then, and some of them go to Management Board of Cabinet. Its members are the link between what goes on at the "cutting edge" and the ministries and agencies they represent. They work hard and long, and I would like you to meet them: From Agriculture and Food, we have George Jackson; from Community and Social Services, Dr. Yuki Torii — it is possible Dr. Torii is not here; from Consumer and Commercial Relations, Tom Seawright and Ray Scott; Culture and Recreation, Stephanie Merrin; Environment, Lyle Parsons; Government Services, Ron Rossetto; Health, Maris Gailitis; Natural Resources, John Kerr; from Revenue, Lou Stadelmann; Transportation and Communications, Barbara Hebel; and from Treasury and Economics, Dr. Kenneth Cheng. I shall introduce the Ontario Hydro member later, but her name is Laura Ives.

Term #1 — ICOGR — was easily explained. Not only can you describe it — but you can see it, as we just did.

Term #2 is "OGRS". This is a new acronym as of last night. It stands for "Ontario Geographical Referencing System". But please do not ask me to tell you what it is. I do not know. But I can tell you something about it.

First: In a way it is a concept which is being developed. It is visualized as a comprehensive information referencing system which would permit visual and rapid geographical correlation of the physical properties, resources, legal status and use of land in the Province of Ontario.

Second: OGRS is a big thing. Not only is it big, but it is COMPLEX! In most simplistic terms, however, what we

are doing is setting up an orderly filing system to replace one which is not orderly. In fact the one we have is so disorderly that people simply cannot use it. There are many government reports which say that our current filing system is in a mess and that we have to do something about it. And so we are — primarily through the medium of ICOGR.

ICOGR is how we get together all the government people who play the information referencing game. ICOGR is the "wheelhouse crew" of the good ship "Ontario Referencing". It is this crew which is charged with plotting the course and setting the direction for the "comprehensive system". We know that a ship sails only in one direction at a time and the bigger the ship the greater the momentum even though it may travel more slowly than a small ship.

Hence, there is the very great need for the course direction to be well thought out and all factors considered before setting it — especially as in this case, we have a very big ship/system.

Now getting back to dry land! I shall not review in detail the events, reports and directives which bring us into the geographical referencing activity. We have been asked to find solutions to the problems of information referencing. Collectively, and individually we are doing just that. ICOGR members have engaged in a variety of activities and have produced many reports on the subject. These are available for the asking.

ICOGR sees the need to disseminate knowledge about geographical referencing. In fact this is one of its mandates. The seminar is one way to do this. This is the second seminar on the subject, the first being in September, 1978. The program has been arranged to provide you with information on activities undertaken. This we hope will indicate to you where we are now, and where we expect to be going in the development of a comprehensive geographical referencing system for Ontario.

ICOGR also sees the need to seek out and gather information from users. This also will be done in the next couple of days. We hope that there will be very specific questions asked — through discussions on the floor. And yes, we have a questionnaire! We need your inputs and will be grateful for them.

We will listen to and communicate with people who have various interests and parts to play in this business of information. We have invited an outsider to our community to take a look at what we are doing and tell us what he sees. Others will be speaking of such things as the perceived information needs of policy makers at both provincial and municipal levels of government, the specific needs of program administrators and how they are going about achieving them, and of course, the state of the art.

We all have interesting experiences to relate including our successes <u>and</u> our failures. If nothing else than a good exchange of information on where we are all at comes from this seminar, it will have been a success. If indeed we come away with more positive ideas on where next we should be going — and how — then we will take away with us an added bonus from the seminar.

A word about delegate participation. The present registration is 250 (about). There are:

21	Ontario ministries, agencies, boards and commissions represented	61%	of registration
31	People from private sector industry	13%	"
27	Different Municipal Governments	11%	"
7	Government of Canada departments/ agencies are represented	6%	"
9	Universities/Colleges	5%	"
5	Provincial governments other than Ontario	4%	"

This concludes my remarks except to introduce the Chairs for Day One and Day Two.

Mrs. Laura Ives will preside over the remainder of today's session. Laura Ives is the second professional forester that I have the pleasure of introducing today. Laura is currently a senior planner in the Land Use Co-ordination Section of the Land Use and Environmental Planning Department of Ontario Hydro. Since graduation in forestry at the University of Toronto she has held a number of positions at Ontario Hydro related to the planning and environmental assessment of transmission facilities. Her keen interest in computer assisted geographic information systems and their applications in planning has enabled her to hold a number of positions on relevant committees such as the Land Use Data Sub-committee and the National Committee for the Formulation of Digital Standards. Laura has delivered several papers at conferences and seminars concerning Ontario Hydro's Computer Assisted Route and Site Selection System, including one at our last ICOGR Seminar in September 1978. Laura is Hydro's member on ICOGR. Laura Ives, would you like to stand and be seen?

Before Laura takes over I wish to introduce the Chairman for Day Two, Mr. Richard Groot. Mr. Groot is a geodesist and a surveyor who has much to do with maps, charts and such things as the National Atlas Program. He is not, however, a professional forester and therefore does not get as extensive a career resume as is given for people who have studied in the natural sciences. He is simply Director, Geographical Services Directorate, Energy, Mines and Resources Canada. Richard was Director of Operations of the Task Force on Geographical Referencing. This means that he is a person who shares our concern for what we do not know about geographical referencing. Richard, would you stand, please? Thank you Dick.

I now ask Laura Ives to take over the Chair for the remainder of today's session. (Applause)

MRS. LAURA IVES, CHAIRMAN FOR MARCH 10, 1981 SESSION
SENIOR PLANNER, LAND USE AND ENVIRONMENTAL PLANNING DEPARTMENT
ONTARIO HYDRO

Thank you very much, Bob. First let me say what an honour I consider it to have been approached to act in the position of Chairman for today. I daresay that when I was first asked to consider this position that none realized that in fact you would be getting two for the price of one . (Laughter) That is, what I'm trying to say for those of you who had not noticed, I am — how do you say it? — just a little bit pregnant. (Laughter) I only bring that to your attention since it means that I am not too anxious to be standing on my feet for long periods at a time today, so you can look forward to short and sweet contributions on my part. In fact, when I was discussing my role with someone at the office the other day, they said: "Well, you are only there to fill in the pregnant pauses". (Laughter) Still I do feel very enthusiastic about the opportunities that this Seminar provides.

ICOGR decided to sponsor a second seminar, the first having been in September 1978, because they felt it was necessary to provide an update or an overview of some of the geographical referencing activities that had occurred since the last Seminar. Specifically, later this morning, Cy Osborne will be speaking to us about the Ontario Basic Mapping Program, and John Kerr will provide us with a literally up-to-the-minute report on the activities of the National Digital Mapping Standards Committee. This afternoon John Kerr and Dr. Linders will provide us with an update on the work done under contract at Guelph on the GEOREF System, and Dr. John Osborn will tell us about a specific thematic application of georeferenced information — that of forest management, which as you may have gathered, is dear to several of us this morning.

The second aim of the Seminar is to determine the direction of the future development necessary towards a comprehensive georeferencing system for Ontario. In view of this, it is recognized that you are a large and diverse audience with a variety of objectives, purposes, interests, etc. in being here. I sincerely hope that that will not

inhibit anyone from actively participating, asking what might seem like a stupid question, or being shy about offering suggestions. I am reminded of something that Charles Darwin is said to have written in 1859, which said: "Looking back, I think it was more to see what the problems were than to solve them." And I have a feeling that is exactly the position we are in today. If we can take advantage of this opportunity to start addressing the problem related to future directions, based in part on a good understanding of where we have been, then I feel that this Seminar will have made a good start.

Before I introduce this morning's speaker, Mr. Ruben Nelson, who will address the subject "Future Directions for Georeferencing", may I be so bold as to suggest some Rules of Procedure for today at least. First, with respect to questions, I am going to suggest that we hold our questions until the end of the day, when I think you will see the agenda indicates that at about 3:30 we have a Question Period. At that time I will reassemble all of the speakers here at the front of the room as a panel, and then you can literally fire away at them all the questions you want. That is, unless our speakers finish early, an event I anticipate is highly unlikely, or something like Coffee or Lunch is not long overdue. One more suggestion, please, please use the microphones that are situated about halfway through the room, if you are going to be asking questions. We will be publishing proceedings, and need to have a record of both the questions and the answers.

I encourage you to browse through the displays that are situated around the perimeter of the room, and I also ask that you bring to my attention as soon as possible, any problems that fall within the category of "physical plant", for lack of a better term — that is if you find it too hot, the lights are too bright or vice versa and you cannot see to write when we turn them out for people who have overhead projectors, or if you cannot hear, I promise to see what I can do about it — and that may be the best offer you will get all day.

With that I would like to introduce our guest speaker, Mr. Ruben Nelson, President of Square One Management, Ltd. — and that is not, as some of us who live in Mississauga would like to think, a shopping plaza management firm, but rather a future-oriented consulting firm.

The main thrust of Mr. Nelson's work is to assist those with whom he works to face, explore, and understand the nature and implications of the most profound social, economic and technological changes which are now taking place in Canada and around the world, and then to shape rather than be shaped by the future. Accordingly, he was hired by the Ministry when it was felt that a review of the results of the recent Guelph Research and Development contract for geographical referencing investigations was in order. It was believed that a consultant from outside the field of geographical referencing activity could best overcome the proverbial problem of not seeing the forest for the trees. Mr. Nelson was assigned the twofold task of making an examination of what is taking place on the "inside", and the implications for the users and public on the "outside". In addition he was asked to report on the sociological factors which could impact geographic referencing and determine the trends in future information handling and use. It is about this most recent work that I expect he will report this morning.

Ruben, may I ask you to join us, please. (Applause)

MR. RUBEN NELSON: Thank you, Laura. Good morning. I want to say how pleased I am to be here. The assignment I was given some months ago by Bob Code has been challenging and taxing. I welcome this opportunity to report on what I found and to test my judgement against yours.

FUTURE DIRECTIONS FOR GEOGRAPHICAL REFERENCING

MR. RUBEN NELSON
SQUARE ONE MANAGEMENT, LTD.

My title is "Future Directions for Geographical Referencing". The first thing I want to note is that we do futures; we begin to look at the future when we're nervous. Think about it. In 1960, we could not have gathered 6,000 people in Toronto or any other city for a Futures Conference. Yet this happened last summer. In 1960, there was no question about the future. We knew what it would be; we knew what it held in store for us. Achieving it was just a question of full steam ahead. However, that is changing. This is caught in an advertisement for the Bank of Montreal. A man says to himself, "What's next? . . . Don't tell me". We are beginning to be nervous and beginning to look at the future.

What is involved in looking at the future? Let me offer you two images.

A secretary is seated at her desk. She is speaking into a telephone. A sign on the wall identifies the firm. It says "Waver and Slide Economists". It could equally say "Shilly and Shally Futurists". The woman says, "We only make predictions; we can't tell what's really happening".

Now bold as it may seem, my interest is precisely the reverse. One of the things that is clear, not only in this field, but around our world, is that predictions are a dime a dozen. Further, almost all of them are wrong! There are even two books on the market that simply compile many of the predictions that have been made over the past couple of hundred years.

The problem is . . . how do you tell a good forecast one from a bad one? My interest is in trying to get under the skin of our culture and in this case of geo-referencing, enough so that we can make some sense of what is really happening. What are the trends and where are they taking us?

I turn to the second image. It is drawn from the humour of Parker and Hart who wrote the Wizard of Id. The king is seated before a fortune teller. He asks, "How does the future look?" "Rosy, very rosy. I see roses for many nations and you're right in the centre of them." is her reply. The king asks, "Are my eyes open?"

That is the basic question, isn't it? Are our eyes open? Can we see the things that our future hangs on? Which brings me to my mandate.

My mandate is as one who is outside the geo-referencing community. I am not a surveyor or a forester, or a director of anything. But I am able to synthesize, to see relationships between things, and I do have a futures orientation. As such I was asked to review developments in geographical referencing and digital mapping, to comment on future directions, what is likely to happen if nothing else changes; and to determine external trends and their impact on geographical referencing. All this in order to be able to answer the questions: Which way should we be moving? What are the issues and how should we approach them? Let me make three quick comments.

First, I am not an expert in geographical referencing or digital mapping. Accordingly, I know all about the stress of learning the difference between a monument and a tombstone, between three degree and six degree projections, between cadastre and something that you heat as an *hors d'oeuvre*. If that is your problem, I sympathize with you, because in the last four or five months, I've had to wrap my head around these things. There will be lots of time in the next two days to wrestle with technical issues. My session will not be one of those times.

Second, my job is to provide an overview. In graphic terms, I run down the side of the next two days' agenda, commenting at various points of it, trying to provide some pattern to the forest. One definition of information is, it's a difference. Well, its human terms which I am

interested in, is the difference that makes a difference. And it is to try to provide things that may be important to the future of geographical referencing, that may not be seen by others. So often where I am silent, it simply means that what I saw going on there seems to me to be fine.

Finally, the basic issue is directions for geographical referencing. Hannah Arendt, who was one of the first females to make a major impact on philosophical consciousness, reminded us that "thinking is always stop and think". It seems to me that instead of just rushing on to attack the problems of geographical referencing, some want to slow down and get a better handle on it.

Here is another image that may help. It comes out of a little book called Gods of Management.[1] (See Figure 1)

There is a fence which separates hungry chickens from their food. The interesting thing is that most of the chickens are so anxious to reach their goal — the food — that they run up against the fence and starve to death. They do not recognize that if they want to get the food, they have to do an end run around the fence. What is more, if you build a "u" shaped fence, all of them starve. It's beyond their comprehension that they actually have to back up from where they are to achieve the goal they want to achieve.

It is an interesting analogy. It suggests that there may be danger in just pushing ahead. This, of course, was recognized by Bob Code. I must say, it is rare and refreshing to find a client who is willing to take the risk of inviting an outsider to come into their midst, with all the blindness that an outsider has, asking him to poke about a bit and inviting him to report on what he sees. Yet this is what Mr. Code, ICOGR and the Ministry did. I think the full credit for the idea should go to Bob Code. The performance of course is mine. If you disagree with the performance, I'm the one you should attack and not him.

[1] Gods of Management: Who they are, how they work and why they will fail. Charles Hardy. London, Pan Books, 1978.

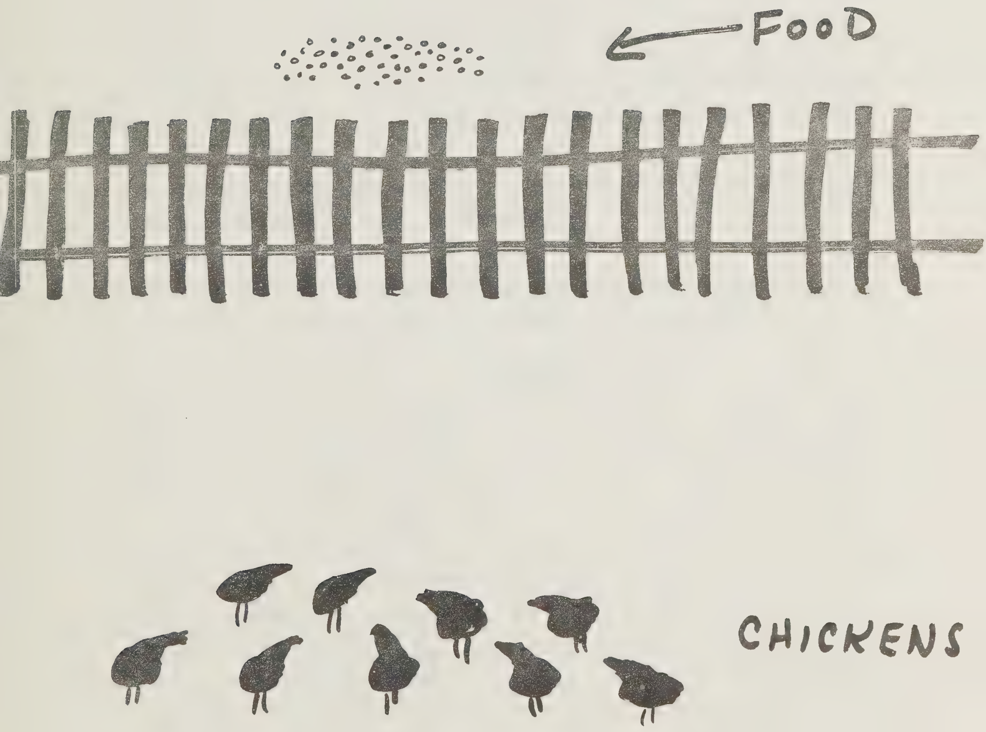


Figure I

The way I went about my task was simple. I spent about ten days talking with a variety of people in British Columbia, Alberta and Ontario. Provincial, federal, municipal and industry organizations were represented. I also spent a lot of time reading, digesting and pondering the mounds of material one comes away with on such a journey.

What are the directions for ICOGR? Which way from here? If you want to know which way from here, the prior question is, where is here? Now unfortunately this is not a question that somebody who is a surveyor or mapper can answer, because there are no geographically referenced coordinates for the present state of affairs. Nevertheless I want first to look at where we have been, then at what is happening, and then at what directions we might take.

Let us look at where we've been. Come back with me twenty years to 1961. I want to consider how things were then. I also want to contrast 1961 with 2001 . . . how things will be twenty years from now. These contrasts should give us a richer sense of where we are today, in 1981. I have set this contrast out in Table I.

<u>TABLE I</u>

1961	2001
ORGANIZATIONS:	ORGANIZATIONS:
• Hierarchical	• Networks
• Self-contained	• Relational
• Bureaucratic	• Holographic
• Inflexible	• Flexible
TASKS:	TASKS:
• Well-defined	• Open-ended, Fuzzy
• Little Change	• Constant Change
• Piecemeal	• In Context
Plentiful Resources	Scarce Resources
MAPPING ORIENTATION:	MAPPING ORIENTATION:
• Geo. Referenced	• Geo Referenced
• Map Sheets	• Information
• Field Collection	• User
• Inventory — Static	• What's Happening
• Little System	• System
• Little Comparability	• Comparability
• Little Derived Information	• Derived Information
• Low Technology	• High Technology
DISTRIBUTION:	DISTRIBUTION:
• Standard Products	• User Specified
• Broadcast Products	• On Demand

In 1961 our organizations were tidily and overwhelmingly hierarchical. Power was at the top. It trickled down from the Minister to the Deputy Minister, to the Assistant Deputy Ministers, and so on, and so on. As Ken Boulding says, "In every organization from root to Crown, ideas flow up and vetos flow down." What is more, our organizations were largely self-contained. Twenty years ago we hardly talked to outsiders, whether we were school systems or even departments within the same government. Citizen consultation and participation were not even on the horizon. Further, we were bureaucratic in the strict sense, meaning divided into different bureaus which were seen as separate and self-contained. For example, I was interested to find out that until recently, a new base line was laid down for each survey. Each was complete in itself, with no useable reference to other surveys. Finally, our organizations and our ways of doing things were inflexible. The paths we pursued were well defined. There were few rewards for innovation. We thought we had enough resources that this way of doing things could go on forever.

It follows that the orientation we had when it came to mapping was that our maps were geographically referenced, but of course they were compatible. The information you had on your sheets might not combine with mine. Further, we developed a "map sheet" orientation. We collected information in the field and stored it on map sheets. We had an inventory of what seemed to be essentially static information. It did not change dramatically, or so we thought.

There was little system, little comparability, little derived information, low technology, and what we distributed to other people were standard products. If you wanted a map sheet of a particular area, I could give you the closest approximation on the scale that I happened to have, and that was it. You had to make do. So I broadcast my maps, in the sense that we gave the same thing to everybody.

Now come ahead with me to 2001, twenty years from now. By then, I suggest that our organizations in large measure will be networks and not hierarchical. Organizations will not be focused at the top. Power, initiative and responsibility will be dispersed throughout the organi-

zation. But the elements will be linked electronically much as the various organs of the body are linked. This will be a monumental change.

Networks by their nature are relational. Accordingly within an organization, there will be a lot more communication, not just up and down, but laterally to the point where the hierarchies which we are all so familiar with, will be obliterated. What is more, organizations will be relational in the sense that they will have leaky borders. Often it will be hard to tell who is inside and who is outside.

Organizations will also be holographic. In a hologram, all of the information contained in the totality is contained in each part. Whereas in a bureaucracy, each part is obviously less than the whole.

Tasks — the work done — will be open ended in a context of constant change. So we will have to pay attention to those who are around us.

Resources will be scarce. There will be an information orientation rather than a map sheet orientation. Many people will not even use graphics, because the information that they are after will be available as text on tables. But the orientation will be to that data as information.

What is more, there will be a user orientation. You will no longer get Brownie points for possessing information, rather you will get Brownie points for helping others actually use information. Further, those who use information will want to know what has been happening through time. How was it yesterday? How will it be today? How might it be some other time? There will be a system, at least in the sense of systematic thoughts and relationships. There will be a good deal of comparability, a high focus on derived information, high technology, and what we distribute will be user specified, rather than a standard product. What is more, it will be specified on demand. You will be able to specify what you want and get it when you want it.

I want to suggest to you that the shift I had there, 1961 to 2001, is not just a shift in technology, but as well is a conceptual shift. It is a shift in the softest of software, namely that between our ears. It is a shift of concept, and of orientation and of logic.

Now the problem, as you can see from Table I is that 1981 is right in the middle and that is our problem. By 2001, we will know what to do and where to go. If we could wait till then before we have to act we would have much less stress. Even if we could wait until 1991 for some of the developments that will occur in the '80s life would be easier. But the problem is, we cannot. There are too many pressures for change. Let us look at some of them.

TABLE II

PRESSURES FOR CHANGE

- Increasing-COSTS
- DIFFICULTY
    - Locate Information
    - Retrieve Information
- PRESENT SYSTEMS AT THEIR LIMIT
- DUPLICATION AMONG USERS
- Increasing-DEMAND COMPARABILITY
- Increasing-DEMAND DERIVED INFORMATION
- Increasing-DEMAND RELATED INFORMATION
- Increasing-DEMAND SPECIFIED PRODUCTS
- Increasing-ORIENTATION TO INFORMATION
- Increasing-ORIENTATION TO USERS
- Increasing-ORIENTATION TO "OTHERS"
- Increasing-ORIENTATION TO:
    - Governors
    - Managers
    - Planners

Costs — increasing costs. Everywhere we are all caught by the cost of staff, the cost of retrieving information, the cost of finding information, the cost of redoing maps, the cost of deriving information from maps, the difficulty of locating and retrieving information. In fact, with a paper base system, it is often cheaper to go out and resurvey than it is to find the information you know you've got somewhere in the files, or you know that somebody else has. Which is to say, we possess a lot more than we use.

What is more, present systems, many of which were set up in the 1950s and '60s are at their limits as filing systems. Further, we are recognizing the immense duplication among map creators. And there is increasing demand for compatibility and comparability so that I can compare what it is you have with what I have.

The demand for derived information and for related information is also overwhelming. Consider, the City of Toronto can now relate its By-laws to geographic areas so that they can tell at a glance which By-laws apply in any given area. If you know anything of the jungle of municipal by-laws, that is an immense gift.

These pressures come not only from our colleagues who are worried operationally, but also from our governors and superiors. Cabinet ministers demand answers to new questions when they find themselves under attack because of, for example, acid rain. Senior managers now also ask policy-oriented questions. Planners trying to think ahead into the future want future scenarios. All of those things are happening to us. They all put pressure on our paper systems.

Now one could deal with many of these pressures within our paper systems, at least for a little while. But ultimately one has to think about systematic geographical referencing and digital mapping. Accordingly, these are high growth areas. These are areas of high interest, as this Seminar indicates. They are also areas of rapid development both in terms of hardware and of software. There is also a high degree of stress.

A proliferation of groups are involved . . . user's groups, manufacturing groups, information creators. There are seminars, conferences and papers, and even a new journal called Geo Processing.

Out of this there are two main thrusts. (1) Let us cooperate, let us share the same base map so we avoid duplication, and we can make our information comparable; and (2) let us digitize.

Now, I think it is important to recognize something that certainly only dawned on me part way through my work. These two are parallel, but not identical. They do not necessarily take you to the same place and they are not necessarily entirely compatible in the sense that if you focus largely on the first you can solve one sort of problem, but it may jeopardize what you are doing in relation to the second; and the reverse. So I think it is terribly important to consider each of these thrusts in turn.

Consider a simple map. It has a given area, scale, projection, georeference, size, accuracy and content. All maps have these aspects, whether they are a hand drawn guide to get to my house, or whether they are very sophisticated maps, as the maps produced by the Ontario Government or the Federal Government in the National Atlas.

Now, if we provided some standard and agreed-upon scale, projection, geographic referencing system and the size of the map sheets, with agreed-upon accuracy and agreed data elements, topography, symbols and toponomy, then in fact we could create enhanced maps. Accordingly we could make a distinction between a base map and an enhanced map and if we did this, we could cut costs, time and duplication. Further, we could increase comparability by simply laying one on top of another. Hence the drive for base maps. It is interesting that in every place with which I talked there is precisely this drive to create base maps.

But note there are pressures to move beyond base maps. There is a whole range of related information that is increasingly desired. Consider the following list:

- History
- By-laws, Regulations
- Construction Type
- Demographic
- Economic
- Ownership
- Mortgages
- Bibliographic
- Tables
- Disease Frequency
- Cost
- Snowfall
- Soil Type

It goes on in principle forever, which is to say for as long as the human mind can distinguish between some aspect of reality that it wants to relate to some other aspect of reality.

And what is more, there is a growing demand for derived information in both graphic and non-graphic forms. Consider the following:

- Calculations
- Conceptual Mapping
- Overlays and Composites
- Measurements
- Modelling
  - Surface
  - Three-dimensional
- Network Analysis
- Proximity Analysis
- Route and Size Selection
- Statistical Analysis
- Topographical Analysis

You may be interested to know that the Alberta Government is now giving oil leases, not only by physical area on the ground, but by zone, three-dimensionally. You have to specify where it is, between what layers you want to drill, and if the oil happens to be below that, or above that, it may be somebody else gets it in the well next door.

The interesting thing is the more you move to a user orientation, the more you are interested, not in possessing simply a map, but in having related and derived information in graphic or non-graphic form. I have mentioned the pressures to develop the capacities. Let me just give you one example. In British Columbia:

> *"Recent provincial forest legislation requires that reports and summaries of forest and range resources be prepared by boundaries which may change frequently or have not been defined previously."* (So they must be able to develop derived information.) *"New forest legislation requires that forest and range inventory statistics be current and hence, basically all maps should be updated annually."*[2]

Think of it, those of you who know the field, the horrendous demand this legislation makes.

[2] Frank Heggi, Director, Inventory Branch, Ministry of Forests, Government of British Columbia.

So we are familiar with the distinction that has been made — base maps and enhanced maps, and related information, which if put together, can give you derived graphics and derived information. Now the interesting thing is that in principle, if you are willing to wait long enough, you can do all of those things with the paper system. True, you would need an army of people working, and you must be willing to wait for the time it takes to stay with the paper system. But of course there are pressures of time which become pressures to digitize.

So let us look at the question, Why Digitize?

TABLE III

WHY DIGITIZE?

- Cut Staff and Money
    - Production
    - Update
    - Metrication
    - N.A. Datum Redefinition
- Speed Map Cycle Time
- Speed Area Display
- Scale Changes
- Create Enhanced Maps on Demand
- Relate Graphics to Text
- Create Derived Graphics/Information
- Distribution
    - Timely
    - More Centres
    - New Clients
- Replace Worn-out Equipment
- Use More Field Information
- Remote Sensing Coming
- Electronic Filing Coming
- Telidon Coming
- Local Networks (Ethernet) Coming
- Word Processing Here

SHARE:

- Common Base Data
- Commonly Required Data
- Costs of Network

First, you can cut staff and you can cut the money. One of the major mapping departments in the Alberta Government figured that over five years if they digitize, that their manpower needs would be 26.8 person years. However, if they do not digitize they will require 183 person years.

What is more, you can speed up production. Then there is ease of updating. For example, consider metrication. That same Alberta Department figured that they could cut from 4.6 person years down to .6 person years when it comes to adapting present information to metric scales. And when it comes to the North American Datum redefinition in 1983-86, they figure they could go from 55.9 person years to 2 person years if they are digitized.

You can also speed the map cycle time. Some places are beginning to talk of ten years or even five years for a complete cycle. Further, if your information is digitized you can have area displays on demand, on line in any office. You can get information almost instantly. You can have whatever scale you are interested in. You can create and enhance maps on demand in case of emergencies. You can relate graphics to text; you can create derived information in graphics. The distribution is not any more time, but it can be in more centres. It can literally be on line eventually, not only in your own field offices in your own institutions, but with a variety of clients, many of whom you do not even deal with now. What is more, you can replace worn out equipment. As I mentioned, a lot of the systems are just at a time where people are going to have to be making major decisions about equipment replacing, in any case, and the question is, do we do it digitally or do we still stay with a paper system?

If information is digitized you can use more of the information that is gathered in the field. One of the things we all know about sheet maps is that only part of the vast amount of field information collected ever goes onto the map.

What is more, there is more to come. Electronic filing is coming. Teledon is coming. Local networks are coming. These are not here, but they are digital and will provide an immense amount of flexibility.

If one had enough money, one could meet one's own needs with one's own system. But if the money becomes critical, then we can begin to share a data base or base data to develop the required data and to share the cost of the network.

So I am suggesting, then, that the pressures that are out there in the world are pressures at the least, to create a common geographical referencing system. But there is more. We must distinguish between that desire and a base map program, which is still map sheet oriented, and the land related information network.

A land related information network presupposes that there be a geographical referencing system in place, in the narrow sense of geographical referencing system.

So now I want to suggest that talk of a "provincial comprehensive geographical referencing system", — this morning you have unveiled to us the OGRS, the Ontario Geographical Referencing System — is systematically ambiguous.

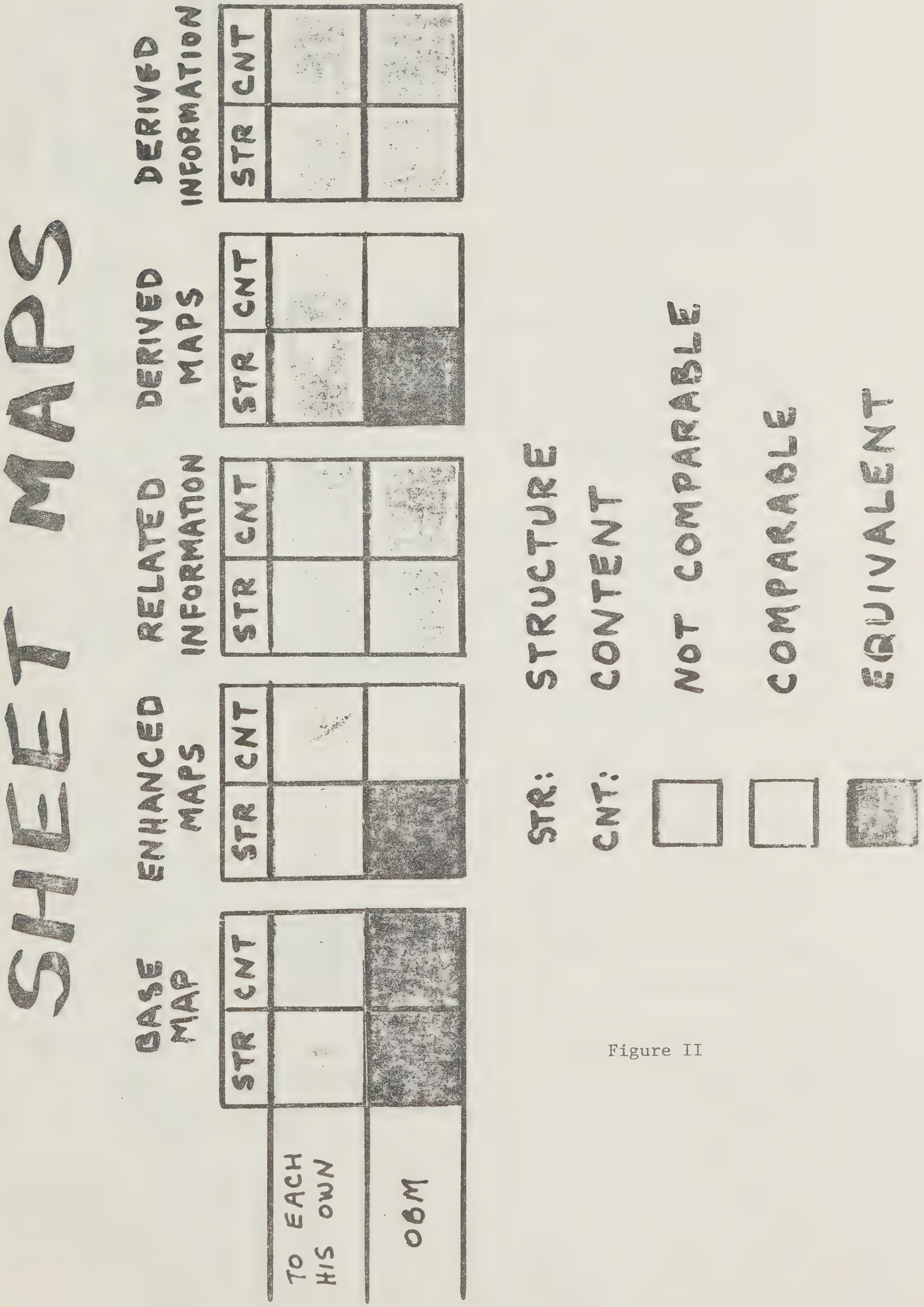
One of the things I have found is that there is some nervousness there as to what it is that is really meant by this. In the strict and narrow sense of geographical referencing system, what one has is simply the agreement that the way we will tie information and location to the ground is by latitude and longitude, or by six degree UTM, or whatever. But do we also mean to include not only a geographical referencing system, but standards, and a systematic series of base maps, and general purpose computer routines for handling and manipulating spatial data and the design and implementation of "integrated distributed geographical referencing data base system"?

I want to suggest that it may be more helpful from the point of view of clarity, to not talk about a "comprehensive geographical referencing system". Rather we should talk of a "comprehensive land-related information network" or, if you like, the "Ontario Land Related Information Network". I make this distinction, not in a trivial way and certainly no way as attack, but in the hope that it may help to clarify. The language of a "comprehensive geographical referencing system" is systematically ambiguous, and as I have suggested, some people are just a little bit nervous as to what is really in store. What is Jim Linders really doing there in Guelph, and will it really help us? Obviously that is not an attack on Jim, or on anyone else. But does it mean that I am going to have a long string to his computer? Or does it mean that if I want to get for my own needs, that I'm going to have to use his software and only his software? What is involved here?

Let us think, then, a little bit further. What I am doing here obviously is taking you through some of my thinking processes to try to get the kind of clarity that may be helpful.

If one is dealing entirely in sheet maps, then you have not got just a mapping orientation, but an orientation to map sheets. With sheet maps you have two choices. (See Figure II). One is that everybody does their own thing, whether it is base maps or enhanced maps, or related information, or derived maps, or derived information in their structure or their content. If everybody does their own thing, there is no comparability. Certainly they are not equivalent.

On the other hand, if you create an Ontario base map that is available in sheet map form, you have a structure and content that is going to be equivalent, and the content will be comparable. OBMs do not do anything in terms of related information. The derived maps are in the same situation. Their structure is equivalent, their content is comparable, but they make no contribution to derived information. This is as far as a sheet map program can take you.


SHEET MAPS
BASE MAP
ENHANCED MAPS
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STR
CNT
TO EACH HIS OWN
OBM
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CNT: CONTENT
NOT COMPARABLE
COMPARABLE
EQUIVALENT

Figure II

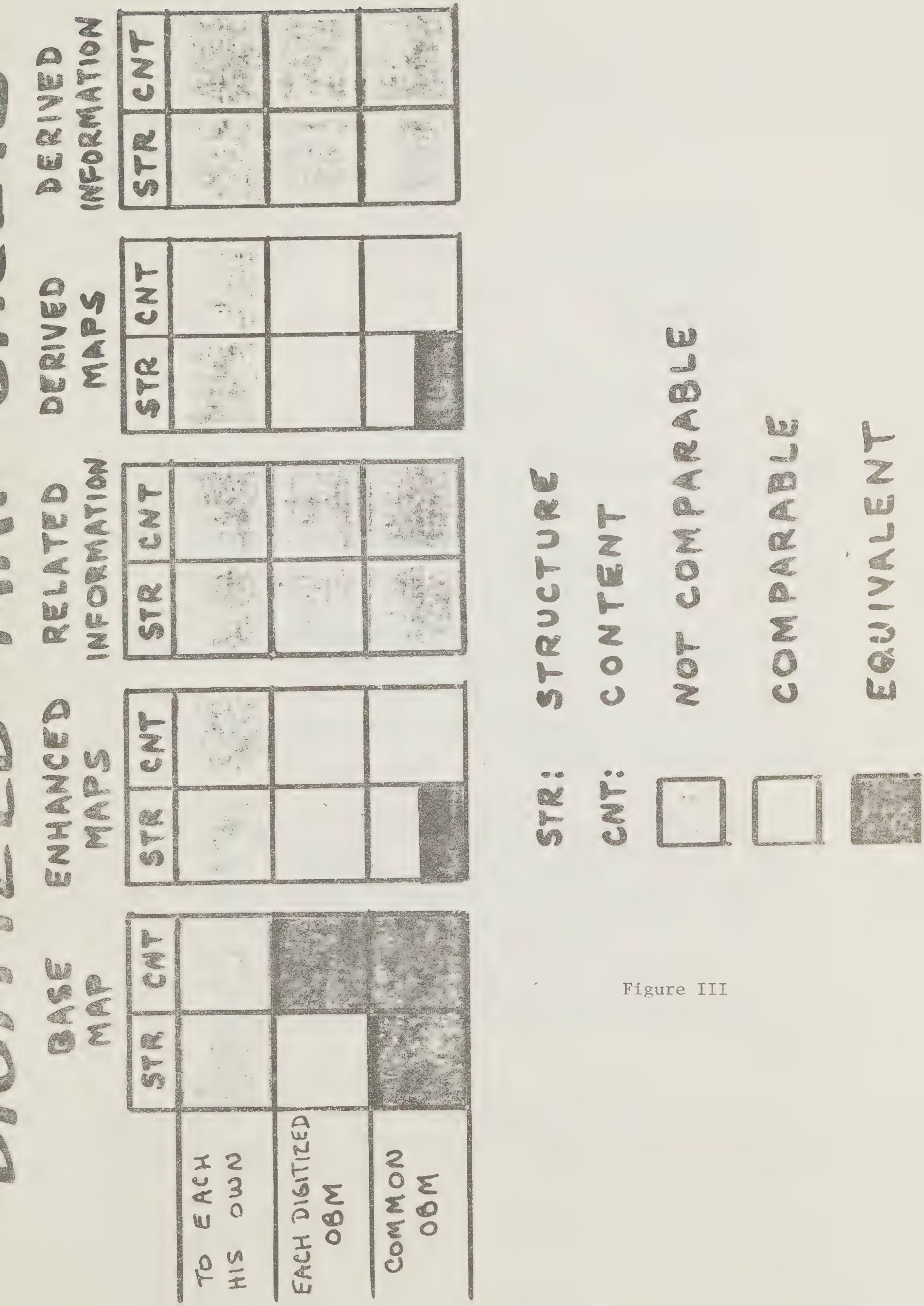
On the other hand, if you digitize, you get at least another option. Consider Figure III. Note that this assumes a sheet map orientation. I do this because I have found that a sheet map orientation is still the common orientation in the field. Accordingly one of the most difficult things to wrap our heads around is the shift from thinking about sheet map products to thinking about an information orientation.

So if you have digitized sheet maps and if everybody does their own then there is still no comparability. That means that each must have enough money to put up their own system, with all the information they need. If some of your information is the same as mine, I hope you have the money to go out and collect it for yourself, because you cannot get it from me.

On the other hand, if each person digitizes a standard OBM map, it may be that the structure of my system is different from yours, so at best the structure of my map is going to be comparable to yours, although the content, because we are working from a common map, will be equivalent. We should get comparable enhanced maps. While our related information is not comparable, our derived maps will be. However, our derived information will not be comparable.

Now we can talk about another option, which is to say a commonly digitized Ontario base map, i.e. one base data that we can all use in our computers. This will give us equivalent base maps and depending on the structure of the systems we are using, the structure may be equivalent or comparable. The content at least will certainly be comparable. But as before, both related and derived information will be non-comparable.

For me, this exercise raised the questions: What are we after? What kind of products do we want? What is it that those who are going to be using these things want? Look at the following Table (IV).


DIGITIZED MAP SHEETS
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CNT: CONTENT
NOT COMPARABLE
COMPARABLE
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Figure III

TABLE IV

WHAT PRODUCTS DO WE WANT?

	Want Product	Want Comparability	Want Equivalence
Base Maps	x	?	x
Enhanced Maps	x	x	?
Related Information	x	x	?
Derived Maps	x	x	?
Derived Information	x	x	?

x — Commonly Desired

? — Desirability Questioned

Certainly the conversations I have had suggest that base maps by their nature provide comparability and that this is desirable. But I have found questions in many people's minds as to whether we need to go beyond OBMs and mere comparability.

However, if one wants systematic land related information, and that is an assumption that this Seminar makes, then one must digitize. Accordingly, one must begin to think about the difference between sheet maps and computers, the relationship then between your data base and my data base and their structure.

One of the reasons I raised the question about objectives — what is it we want? — is that to talk of an Ontario Geographical Referencing System or to talk of an integrated distributed geographical referencing data base system, does not make it clear as to which it is that one is opting for. Are we opting for equivalence of structure and content, or mere comparability? Are we working towards a network based on a single main frame computer or a series of semi-independent mini-computers?

Now the interesting thing is that nobody seems to be interested in a single network based on a main frame computer, although there is some anxiety that that is what Jim Linders is doing. He will want to tell you himself — that is not what he is doing, but I have run into some anxiety that that's what the case is. Also, this perception is held

by some outside the Province, that is what Ontario is doing. There is a certain amusement that Ontario would take that approach.

What one is really arguing about is the degree of comparability we want, and the relationship between our hardware.

Before you can make that decision as to what one should try for, let us back up a bit and talk about context. What is happening out there in the world? What are some of the trends?

Now a couple of interesting things about context, one is that it is subtle and hard to see. By definition, things that are contextual to us are on the periphery of our vision and they are themselves subtle. It is interesting that as a society we give over to our women the sensitivity to context and sensitivity to that which is subtle. Those of us who are male have been given the social roles of getting out there and zeroing in on things and getting on with it. Listen to the words. Women provide and create context and pay attention to subtlety. So it is not an accident that some of the largest corporations in North America are appointing women as their chiefs of strategic planning.

Another thing, because context is subtle, concepts necessarily lag behind changes in hardware. This is an observation, not an accusation. Consider, we called the automobile the horseless carriage before we called it an automobile. Even after we called it an automobile, it took a long time to recognize that this really is an "auto" "mobile". It lets individual people or very small groups of people do what they want, when they want it. It's a dramatically distributed system.

In the same way we first called a locomotive an iron horse. One can also see the way we use television in schools. I do not know about you, but I do not know anyone who gathers in a large group to watch television, except in university class rooms. There, TV is used as a single presenter making a presentation. In universities, 200 or 500 and in some places 1,000 students all watch the little monitor together. It's

a marvellous example of misperception even though the institution is paid to pursue truth and to worry about the future.

So it seems to me it may be a mistake to still call computers "computers" rather than information processors. This shift is not just semantic — it is dramatic. Information processing is a very different thing than merely computing. What it does for us is process information, and the struggle is to get into an information orientation.

So let us look at some trends. I suggest to you that these words capture some of the underlying trends of the culture.

FROM:	Static	TO:	Dynamic
"	Piecemeal	"	Relational
"	Function	"	Territory
"	Data	"	Patterns
"	Print	"	Electronic
"	High Growth	"	Low Growth

We are slowly moving from a static orientation to a dynamic orientation, to the sense of things happening in time and you need to specify when. It was different yesterday, somewhat different today, and it will be different tomorrow. And this is true, not only for geographical referencing, but right through the society. One pays attention to it in Einstein in physics, or in our own lives. For example, the book PASSAGES which says quite openly that all of us continue to change through our whole lives, is a dramatically different image of being an adult than that which our grandparents had. For them, once you had grown up you were fixed and you did not change.

And we are moving from a piecemeal orientation which deals with fragmented things one at a time, and which deals with things exclusively within set boundaries, to relational inclusive ecological orientation. That is, we are discovering it is not just the quarter acre in a particular swamp which foresters have always known has had ecological relationships, but the whole earth, including you and me, is involved in ecological relationships. Therefore one must look after relationships. It follows that they must be integrated, whether one thinks of organizations, persons, maps or information.

What's more — and this is less seen — there is a slow shift from function as our main focus of dividing up the world, to territory. This becomes terribly important when it comes to geographical referencing. As ordinary human beings, we locate ourselves territorially. We are Canadian, or Torontonians, or from Calgary, or whatever. From that point of view we are interested ecologically in all of the things that go on around us. Whereas the world that we are part of and we have to deal with, is divided up into separate functions. You do mapping and somebody else drills wells, and somebody else plants trees. However, there is an increasing pressure to say that the fragmental functional focus will not do. What we want is territorial focus. Now, of course, the territorial focus means you have to be able to locate what it is that happens there or what it is that is there in a territory someway, which takes you back into geographical referencing. In short, we are discovering that our earth is our only common address; that it is our home in a fundamentally different way. We are discovering that we live in the earth, and not merely on it.

We are focusing not only on bits of data but on whole patterns, hence the importance of derived information. It is a shift from print to electronic world and a shift from a world that presumes increasing GNP, to at best an essentially flat GNP and that is one of the conditions that is going to touch us.

I suggest that if you put those images together, one ends up in a fluid world that really is in transition from an industrial society. We have gone from a hunting and gathering society through an agricultural society to an industrial society to a society of social technology which is now moving into an information society. This is the context in which one must set our concern with future directions for geographical referencing.

What, then, are the directions for geographical referencing and for ICOGR?

For geographical referencing it is going to be clearly towards more land related information, towards more use of it by more people, more computers, more pressure to share, more demand for flexibility, more user orientation.

For ICOGR it seems to me it pushes towards a land related information focus. That, I think, is the focus that is already there, but as I suggested earlier the language of 'geographical referencing system' is ambiguous. There will be more participants. While geographical referencing right now is inside the Ontario Government, it seems to me that one needs to let in a wide variety of people into the discussion — people who are not now directly involved. More participation, greater comparability, at least ensuring translatability which pre-supposes, I think, a major review of the real needs of specific users, the technology over the next five years and information regarding land related information, its sources and needs.

Allow me to note that if you have not read the report of the first ICOGR Seminar, you should — it's a very good document. It was a very good Seminar. One of the things that is noted there is the need for greater information sharing. Now to the response I advocate.

The key is some kind of system for locating things on the ground. The earth is our only common address; its use will grow as we discover that whatever is physical, whether it is air masses or human beings, is locatable, because it is only in one place at once. Such addressing systems must at least be translatable. This argues for a geographical referencing index for coordinates, for survey control and other fixed points which I believe is the COSINE program.

I advocate a focus on land related information "network". I put "network" in quotes, because as I have pointed out, the question of the links between the computer that is in your office and the computer which is somebody else's is a major and as yet unresolved issue. We also need a focus on land related information and not just "map sheet" focus. This, too, raises questions.

If the orientation that we are going through as a society is as profound a re-orientation as I think it is, then we will have to work at consciously developing a user orientation, and an information orientation for all land related information. We must also note that a user orientation and an information orientation has implications, not only for the relations between our organizations, but for the relations within each of our organizations. These are crucial as the conceptual and organizational reforms inherent in digital mapping are often ignored in these discussions.

"Hands-on" experience is absolutely essential, because what happens in our head and what we do with our hands is deeply related. Hence the importance of a variety of people developing their own systems. This gives them enough experience so that they can talk knowledgeably about these things.

Now I want to suggest there are no Brownie points for a provincial government if it develops, wholly in-house, the creation of the next generation digital mapping system. It is one thing to do R&D as MNR is doing with Jim Linders, but it is another thing for the government to see itself as creating the next generation of systems. This suggests there are limits to in-house government activity, even if there is no clear line indicating the limit.

One issue that I found that no one in digital mapping is talking about is the issue of industrial strategy. Now the normal pattern is occurring, which is to say that Canadians see a need, and we are meeting that need in large measure with American technology and American hardware purchased in bits and pieces. It is beginning to dawn on us in Canada, that there are enough of us who have an interest in digital mapping that if we learn to talk to each other, we have the basis for a viable Canadian industry. Government procurement and other institutional procurement can be used to enhance our nation, our work force and our future. This issue is not now on the table. It needs to be.

One further issue. There is no systematic information sharing within Ontario or within Canada regarding developments in relation to land related information systems. There is an irony here. One of the great concerns behind developments in geographical referencing and digital mapping is the concern that information should be available and of use to many different users in many different situations. Yet this same concern to share information has hardly been manifest, let along operationalized regarding developments in land related information systems.

The recommendations then:
First, carry on in the areas of extending geodetic control, creating base maps and worrying about making that information in digital form translatable.

Second, it is time to pause and re-group; to cast the net wider. For example, there is a need to identify all those with an active or potential interest in an Ontario land related information network. There is a need for wider participation in deliberations, in studies, and in decisions about these things. For example, some of the work that needs to be done could be done on a much wider cost shared basis. There is a need to create a body to monitor developments regarding land related information and to serve a clearing house function. Now there is no single place one can go to find information on the latest developments. There are no people whose job it is to monitor developments and to assist others to understand them. As I mentioned, there is an education function to be met, which these seminars meet in part. There is also room for a whole range of local seminars in many places to identify the real needs of users; to help people understand the changes taking place and what the technology can do for us; and to keep us from being mesmerized by technology.

There is a need to do a detailed survey of the real needs of major government and non-government users in the '80s. I say "real" needs here. They are not easy to get at. One cannot just talk about needs for digital mapping with a group of people whose whole orientation has

been towards surveying and mapping with map sheets. It is like asking a ten year old child what they will want when they are sixteen. We all know that puberty brings with it a dramatic reorientation. So sixteen year olds have a fundamentally different set of interests than ten year olds. The interesting thing is that ten year olds do not know it. So if you systematically surveyed ten year olds and asked what they think they will need when they are sixteen, you will get systematically misleading data. So with digital mapping. We must talk to potential users long enough, in enough depth to work it through to their real needs.

Third, it is time to do some hard-edged comparative work with the turnkey systems that are now coming on the market. A detailed study should include tests of technology which should be available by 1985. The study should also work through the implications of such technology for a land related information network.

Fourth, in the light of all this there is a need to review the focus, mandate and make-up of ICOGR. Now it may be that the Ontario Government needs a group that is limited to the departments of the Ontario Government. I do not question this at all. But there is also a need for some kind of group or network which would systematically include all of those in Ontario who have an interest in digital mapping.

Let me close then, with a quote from James Clapp and Bernard Nieman, Jr. in a paper they did in 1977. "Computers' control of remote sensing are essential to the development of modern land information systems, but these technologies must be applied with institutional awareness, cooperation and probably reform." There is no question about the need for reform. The style must be essentially gentle. We are all going through a fundamental reorientation from an orientation to map sheets to an information orientation. We are working out new sets of institutional relations as we go. I want to accent the importance of building a community of interest. As Paul Ziff has said: "A community

of interest is not given but it can be striven for." Right now there is no community of interest around land related information networks. There is a whole variety of people who have a piece of the interest, but there is no community with a common interest. It is not now given. On the other hand it can be striven for, and that is the task before us. Thank you.

CHAIRMAN IVES: Thank you very much, Ruben. In taking me through some of your thinking processes, I must say you took me through a lot of my own thinking and I am sure there are a number of comments you made that all of us personally related to. You have certainly given us a lot of food for thought and it is my understanding that you will be with us this afternoon so that when people want to question you about anything you have perceived or your recommendations from those perceptions, they will have an opportunity at that time.

What I would like to suggest now, having had some food for thought, it is perhaps time for food for the stomach. It is my understanding that coffee, tea and juice are being served in the Superior Room, immediately to the north. I know it is going to be a very difficult task to achieve, but I would like everyone to be back here in about fifteen minutes, which according to my watch should be about five to eleven. Perhaps we can strive for that and then get back on with the program.

— COFFEE BREAK —

CHAIRMAN IVES: First I would like to apologize for the coffee break and how awkward it was to get a cup of coffee. We are going to try to work something out on that — that is one of the promises I made at the beginning of the day — that is, that I would work on some of those physical plant problems. So we will see what we can do about it this afternoon. Thank you very much for getting back here as quickly as you did.

It is now my privilege to introduce to you a relative newcomer to the Provincial Government I understand, at least from an employment point of view. Cy Osborne who is on my right, joined the Surveys and

Mapping Branch of the Ministry of Natural Resources as General Manager of Mapping Services in November, 1980, after a variety of survey and mapping experiences, including a number of senior positions with the Federal Government at Energy, Mines and Resources Canada. He brings his characteristic wit today to the subject of the Ontario Basic Mapping program. Cy. (Applause)

CY OSBORNE: It sounds different when she says it. (Laughter)

UPDATE ON THE BASIC MAPPING PROGRAM

CYRIL T. OSBORNE
MAPPING SERVICES, MINISTRY OF NATURAL RESOURCES

Introduction

I propose to do somewhat more than give you an up-date since I understand that some of you have not been exposed to our travelling dog and pony show before — a show that we are prepared to give at the drop of a hat!

The presentation is accompanied by slides (so for those of you who have had it all before this is an opportunity to catch forty winks) and, broadly speaking this presentation covers:

(a) the problem as it existed;
(b) what the response was as one solution; and
(c) examples of the program products and their uses.

THE NEED FOR BASIC MAPPING

The first slide identifies the problem as one of access to information. It was never a question that there was not enough geographical information — it existed for a particular purpose but it couldn't be used for any other purpose because there was no way of establishing the relationship of separate information cells.

Slide 1: Access to Information

WHAT WAS THE PROBLEM?

- *Information known to be in government maps and files was virtually inaccessible because it was not described consistently by geographic position.*
- *The Committee on Government Productivity, the Law Reform Commission, the Ontario Economic Council and many others have drawn the Government's attention to the problems during recent years.*

: :

Investigation of the problem defined the causes as being those you see on Slide 2:

(a) no reference framework;
(b) no integrated mapping system with accurate topographic maps for general use, and

(c) no chief honcho responsible for the positioning kit and caboodle.

Slide 2: Causes

CAN THE CAUSES BE IDENTIFIED?

- *No commonly accepted and readily available reference framework.*
- *No accurate topographic maps, systematically organized at suitable scales.*
- *No one responsible for basic mapping and the grid.*

: :

The next slide shows somewhat more graphically the situation that existed. The value of a grid was recognized by all users for referencing purposes, but each mapping agency — public or private — used its own grid. The result was that a feature could have several references associated with it.

Slide 3: Feature Referencing, Horizontal

SEE SLIDE — Page 44

- *Feature 'A' can be referenced to many grids.*
- *There should be one commonly accepted grid.*

: :

From a mapping standpoint, this was the situation. This is a comparison of the same features on federal and provincial maps — differences in position of up to 1/4 mile. And these are the ones we know about!

Slide 4: Horizontal Differences in Position — FRI and NTS.

SEE SLIDE — Page 45

: :

But the discrepancies don't stop at position — differences in elevation also exist, as you can see, up to almost 100' in some cases. You may not know it, but it is likely that some of you have been skiing uphill for years!

Slide 5: Vertical Differences

SEE SLIDE — Page 46

- *Difference in elevation (feet) between Federal and Provincial values.*

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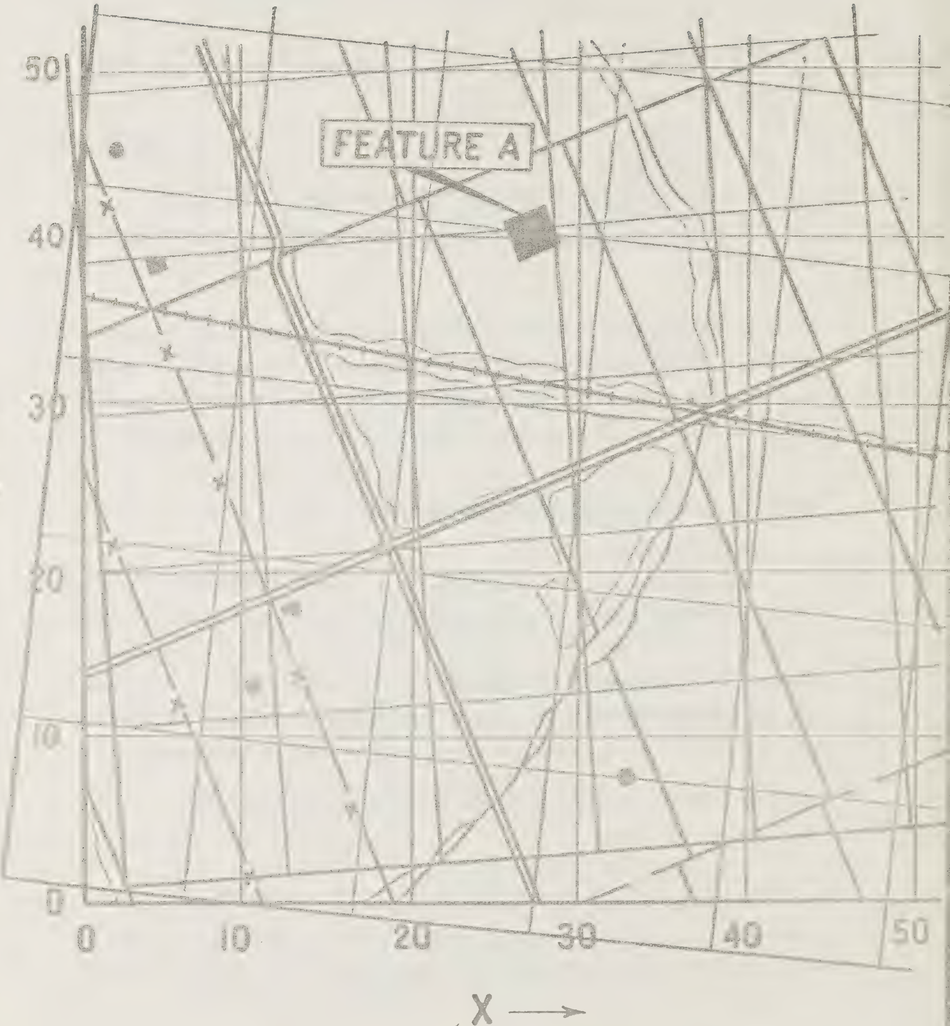
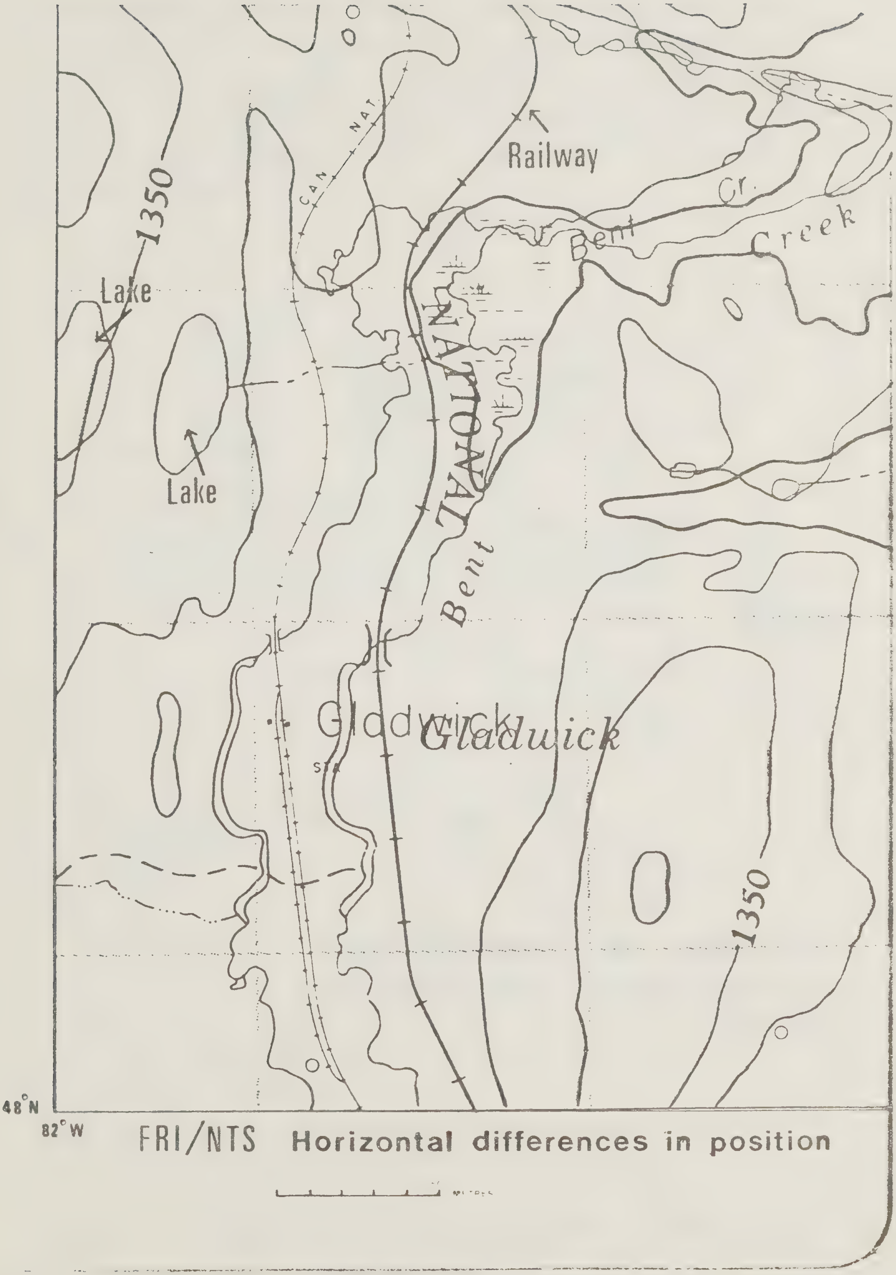


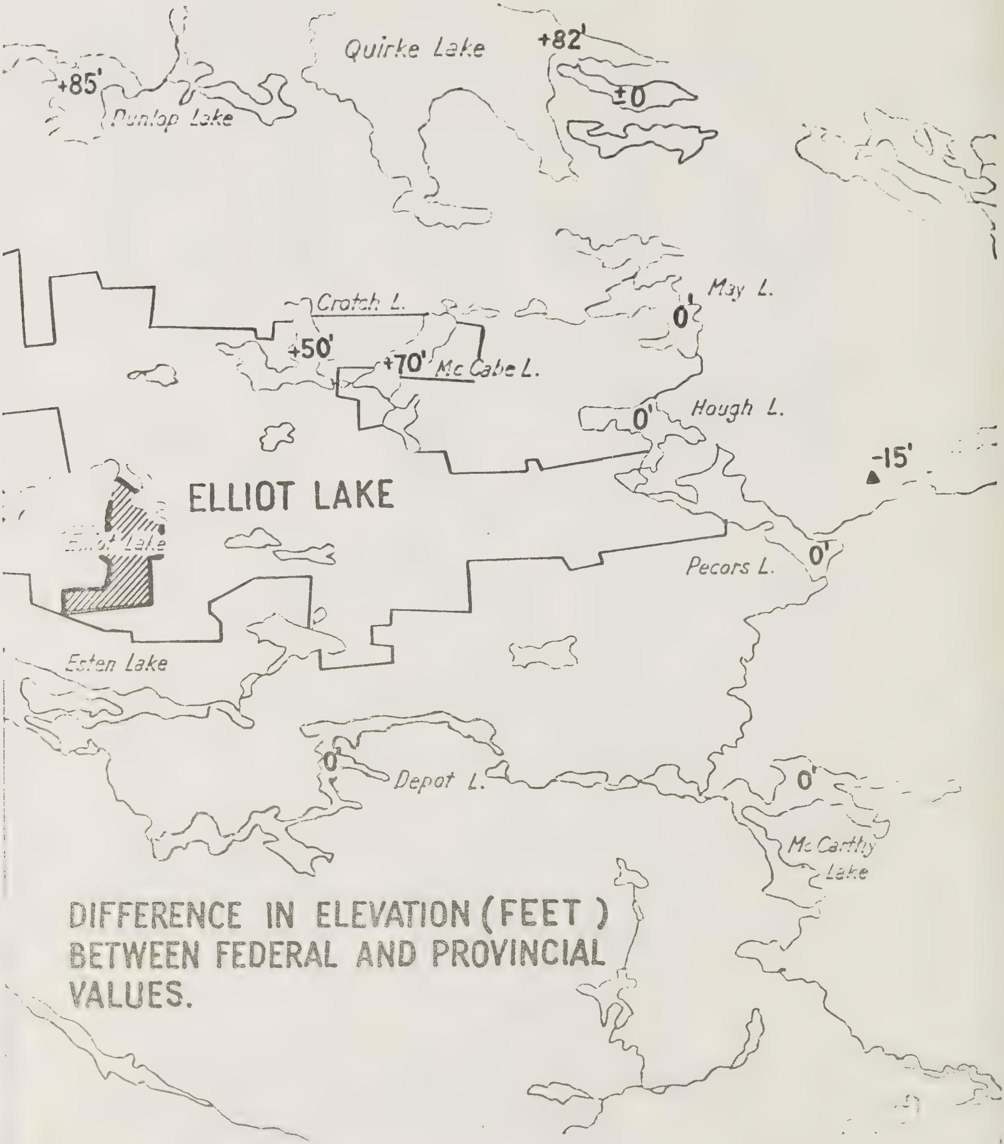
Feature A can be reference to many grids.
There should be one commonly accepted grid.

Slide 3



FRI/NTS **Horizontal differences in position**

Slide 4



FRI/NTS Differences in elevation

Slide 5

Furthermore, from a different perspective the Province also appeared to be 'under-mapped'. If large scale topographic map coverage is in any sense a measure of effective resource and land management, then the Province is certainly at the low end of the totem pole!

Slide 6: Status of Mapping at Scales of 1:25 000

STATUS MAPPING, 1974

- *Topographic map coverage at scales 1:25 000 and larger*:*

Percent of Area Covered 1974	*Locality*
13.1	*World Average*
66.6	*Europe*
25.9	*North America*
18.7	*Oceania*
14.6	*Asia*
8.4	*South America*
4.0	*Ontario (estimate)*
1.2	*Africa*

**Scales suitable for provincial and municipal use. (Source: Brandenberger, United Nations Economic and Social Council, Study on the Status of World Cartography, 1976.)*

: :

That is not to say that there were no maps — they existed in abundance, as you can see!

Slide 7: Existing Map Sheets

PROBABLE NUMBERS OF EXISTING MAP SHEETS IN 1978

Agriculture	*100 +*
Environment	*350 +*
Housing	*25 +*
Natural Resources	*30,000 + rising to 60,000 + in 13 years*
Revenue	*25,000 +*
M.T.C.	*125 +*

: :

So, to re-cap the problem:

- no reference framework;
- no integrated mapping system;
- no one responsible for what has now turned out to be the GEOREF System.

THE GOVERNMENT RESPONSE

Having identified the problems the solutions followed quite naturally and they are:

- choose a suitable reference framework and use it;
- establish a basic mapping system to serve most purposes, and
- assign responsibility for basic mapping and referencing to one agency.

Slide 8: Solutions

WHAT ARE THE SOLUTIONS?

- *Choose a suitable reference framework and use it.*
- *Provide systematic, accurate uniform up-to-date mapping, at scales suitable for most provincial and local authority purposes.*
- *Assign responsibility for basic mapping and referencing to one agency.*

: :

The Cabinet policy statement of July 1977 was the government response which did just this and authorized the Ministry of Natural Resources to implement the Ontario Basic Mapping Program.

Slide 9: Cabinet Policy

ONTARIO BASIC MAPPING

POLICY (Cabinet Statement July 1977)

- *Prime responsibility for OBM policy to be assigned to the Minister of Natural Resources, who should develop basic mapping programs, maintain the integrity of the provincial referencing grid and negotiate respective responsibilities for basic mapping with the several levels of government.*

PROGRAM (Cabinet and Management Board statements July 1978)

- *MNR authorized to implement the Ontario Basic Mapping Program.*

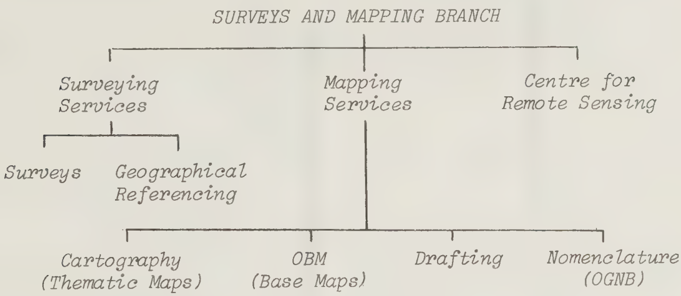
: :

This responsibility fell to the Surveys and Mapping Branch, within which there are now two units doing what has to be done. Geogra-

phical Referencing is the responsibility of the Surveying Services and Basic Mapping is with Mapping Services.

<u>Slide 10</u>: <u>The Mapping Organization</u>

NATURAL RESOURCES MAPPING ORGANIZATION



: :

As for the referencing system, the choice of the Universal Transverse Mercator System as the basis for georef and mapping was fairly straightforward since, as you can see, it is used fairly extensively.

<u>Slide 11</u>: <u>A Suitable Grid</u>

WHICH GRID IS THE MOST SUITABLE?

- *The Universal Transverse Mercator Grid System (UTM) is internationally accepted and is used in more than fifty countries.*
- *The official Federal Government grid is the UTM.*
- *It is very suitable for surveyors and map makers.*
- *Policy makers, planners, engineers, scientists, land managers like it.*
- *Local authorities have started to use it.*
- *Nineteen Ontario Ministries have endorsed it.*

: :

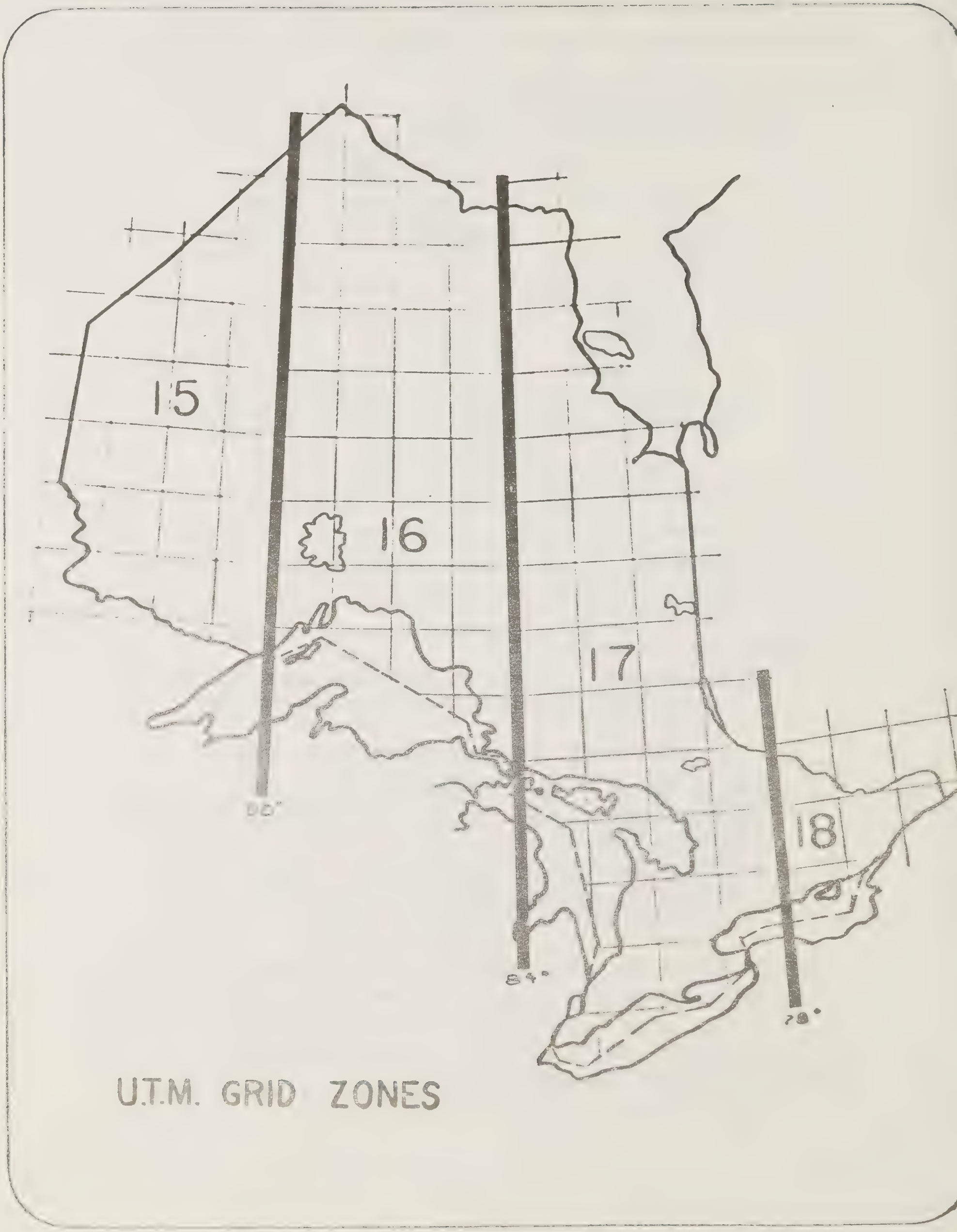
In Ontario this is what the referencing framework looks like. The numbers are important as you know or will come to appreciate, because they are needed to tell you where you are uniquely in the system.

<u>Slide 12</u>: <u>The Grid in Ontario</u>

SEE SLIDE — Page 50

- *U.T.M. Grid Zones*

: :



Slide 12

As far as the mapping program itself is concerned, complete coverage of Ontario is planned at two scales — 1:20 000 in the north and 1:10 000 in the south. In the north there is an area to be covered by photomaps but this is because it would really be uneconomic to give it the full treatment because of the characteristics of the topography. In addition to this area mapping, each community will be mapped at a scale of 1:2000 under a cost-sharing agreement with the municipality concerned.

Slide 13: The Mapping Program

SEE SLIDE — Page 52

- *Area Mapping*

: :

The program cost at just over $100 million is not too horrendous for what we get . . .

Slide 14: The Cost

WHAT WILL THIS COST?	*1980 Dollars*
• *Start-up (three years*	*$5 Million*
• *Full Production (ten years)*	*$100 Million*
• *Thereafter - Revision and Maintenance*	*$5 Million Annually*

: :

. . . and all the work will be done by industry. This will help to provide the industry with a stable base and, it is hoped, improve their competitiveness in the international market, leading to increased employment.

Slide 15: Estimated Employment

DOES THIS CREATE ANOTHER BUREAUCRATIC EMPIRE?

- *No. Industry will make and revise mapping. Government will monitor production and ensure adequate distribution.*
- *Employment figures:*

	Start-up Period	*Full Production Period*	*Maintenance Period*
Government	*12*	*58*	*58*
Industry (from program)	*36*	*95-105*	*82*
Industry (from foreign spin-off earnings)	*—*	*142-157*	*123*
Total:	*48*	*295-320*	*263*

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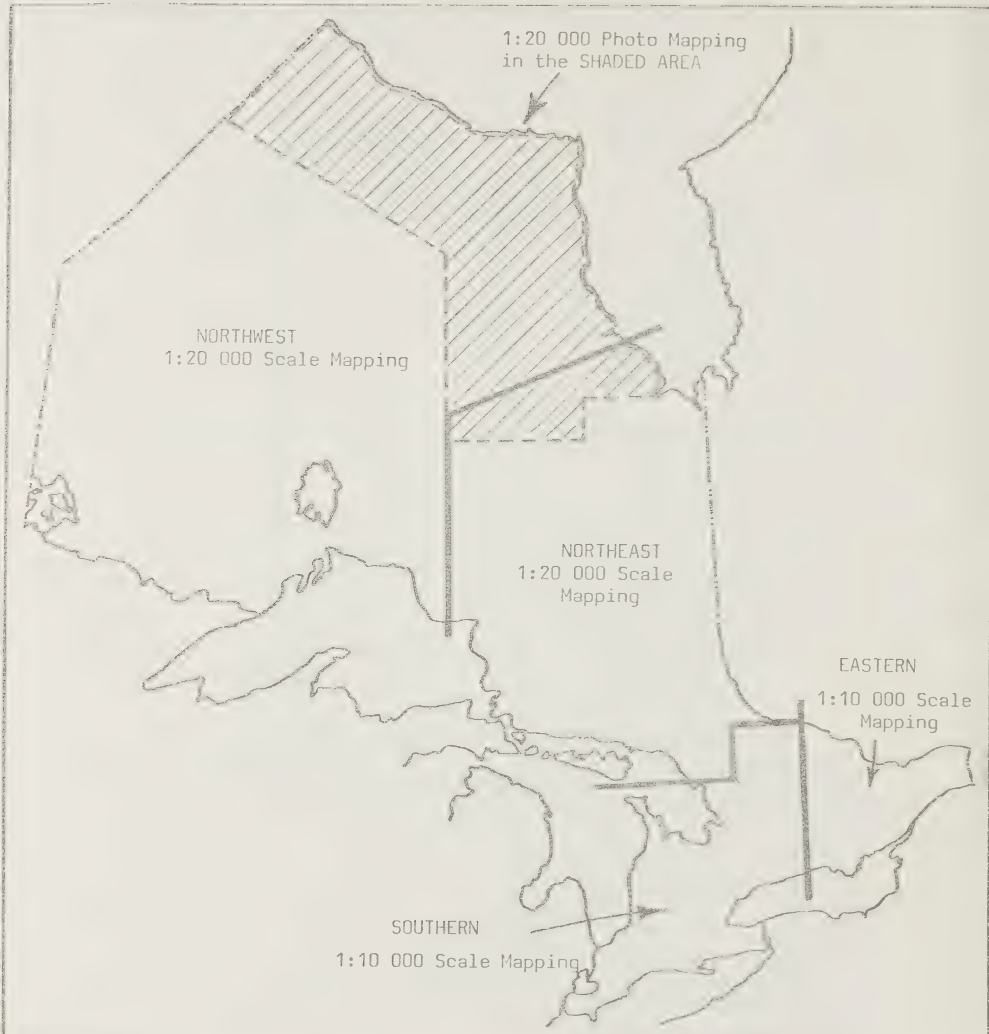

Basic Mapping - Provincial Divisions and Mapping Coverage

Slide 13

Some additional benefits have also been estimated over a period, 21 years, which includes the thirteen-year period for the initial mapping and one complete revision cycle. My own opinion is that this is a conservative estimate because there is a tremendous appreciation of the investment over time.

Slide 16: Benefits

WHAT WILL BE THE BENEFITS?

- *Consider a 21-year period, full program level:*

	Expenditures	Benefits
CAPITAL		
Purchase of original maps at cost	$62,000,000	
Value of fixed assets maintained, no write-off		$62,000,000
OPERATIONS		
Map revision, administration, marketing, monitoring	$81,000,000	
Reduction in present Government mapping expenditures		$85,000,000
Time saving to users (corporate and Government sector)		70,000,000
Employment		
— directly from program		110,000,000
— spin-off due to increased foreign earnings		93,000,000
Operations Totals:	$81,000,000	$358,000,000

: :

This was the information needed to get the program off the ground. In the discussion so far, I have simplified the program development process to the point where many of you might want to dash out and become policy analysts. This slide will, I hope, stop the adrenalin running just a bit! The process, from problem definition to program approval, took just under ten years — and I don't believe that one can even be sure that the dark days are over!

Slide 17: Policy Development

SEE SLIDE — Page 54

- *Hope versus heartbreak consolidation.*

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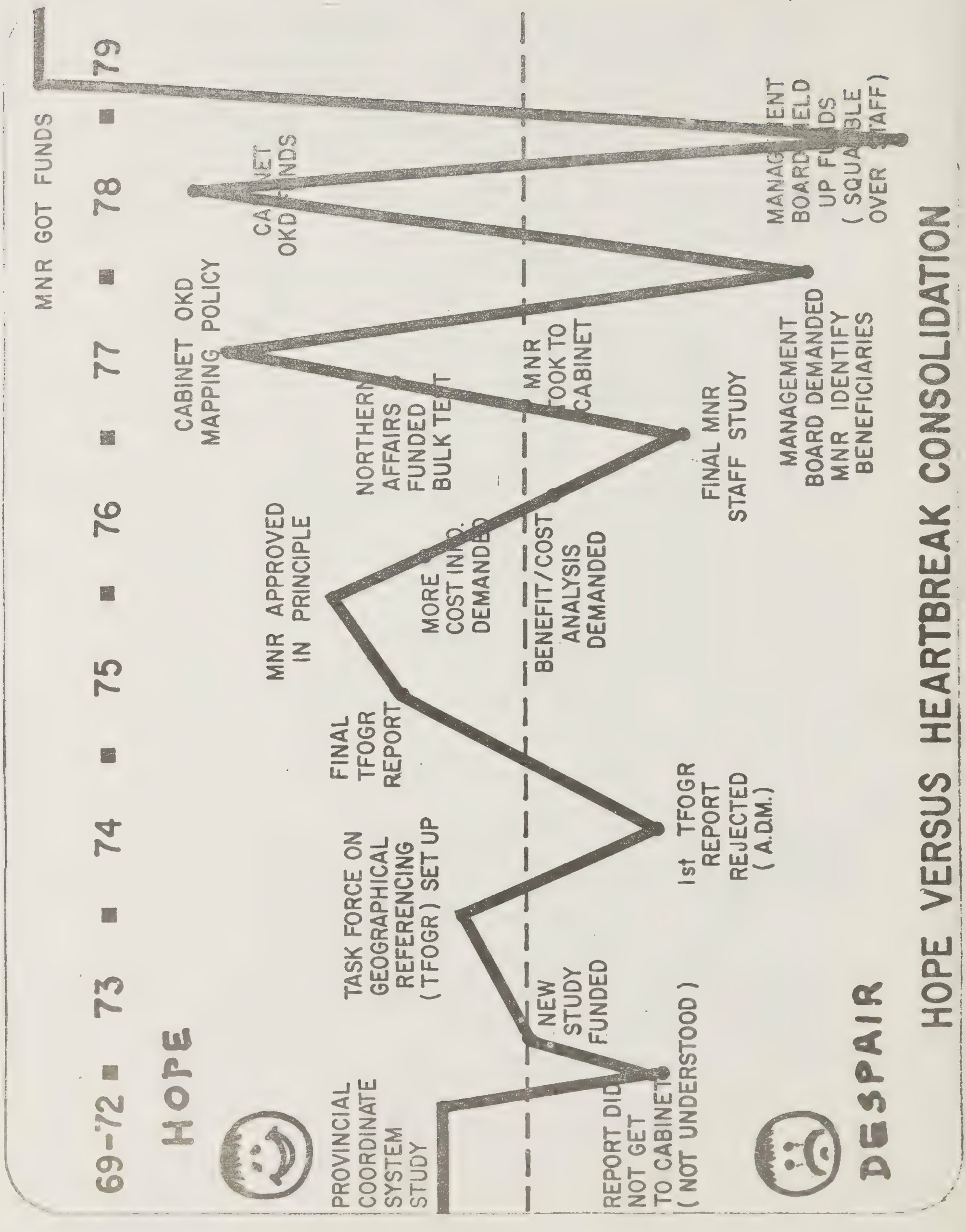

HOPE VERSUS HEARTBREAK CONSOLIDATION
HOPE
DESPAIR
69-72
73
74
75
76
77
78
79
PROVINCIAL COORDINATE SYSTEM STUDY
REPORT DID NOT GET TO CABINET (NOT UNDERSTOOD)
NEW STUDY FUNDED
TASK FORCE ON GEOGRAPHICAL REFERENCING (TFOGR) SET UP
1st TFOGR REPORT REJECTED (A.D.M.)
FINAL TFOGR REPORT
MNR APPROVED IN PRINCIPLE
MORE COST INFO. DEMANDED
BENEFIT/COST ANALYSIS DEMANDED
NORTHERN AFFAIRS FUNDED BULK TEST
FINAL MNR STAFF STUDY
MNR TOOK TO CABINET
CABINET OKD MAPPING POLICY
MANAGEMENT BOARD DEMANDED MNR IDENTIFY BENEFICIARIES
CABINET OKD FUNDS
MNR GOT FUNDS
MANAGEMENT BOARD HELD UP FUNDS (SQUABBLE OVER STAFF)

Slide 17

THE PROGRAM PRODUCTS

Now to the good stuff — the program products. Priorities for mapping are established by an Interministerial Priorities Committee, made up of representatives of ministries that have contributed to the program. The Committee establishes the area priorities, which are then applied to both the area mapping and the community mapping within the block. Priorities determined and approved in January 1981 are shown here.

Slide 18: Mapping Priorities

SEE SLIDE — Page 56

- *Priorities for 1981*

: :

This is an example of a typical OBM area map. For those of you who haven't seen any of these OBM maps before, note particularly:

- that it is in one colour,
- that the surround is as simple as possible,
- that it is square, 50 cm by 50 cm, as are all OBM maps, and
- that it has a referencing grid.

In short, it is a basic map to which users can easily add their own thematic information.

Slide 19: 1:10 000 Map

SEE SLIDE — Page 57

: :

This example is of a 1:20 000 map in Northern Ontario, with the area covered by 1:2000 mapping of the community of Spanish identified to show you the relationship of the two scales.

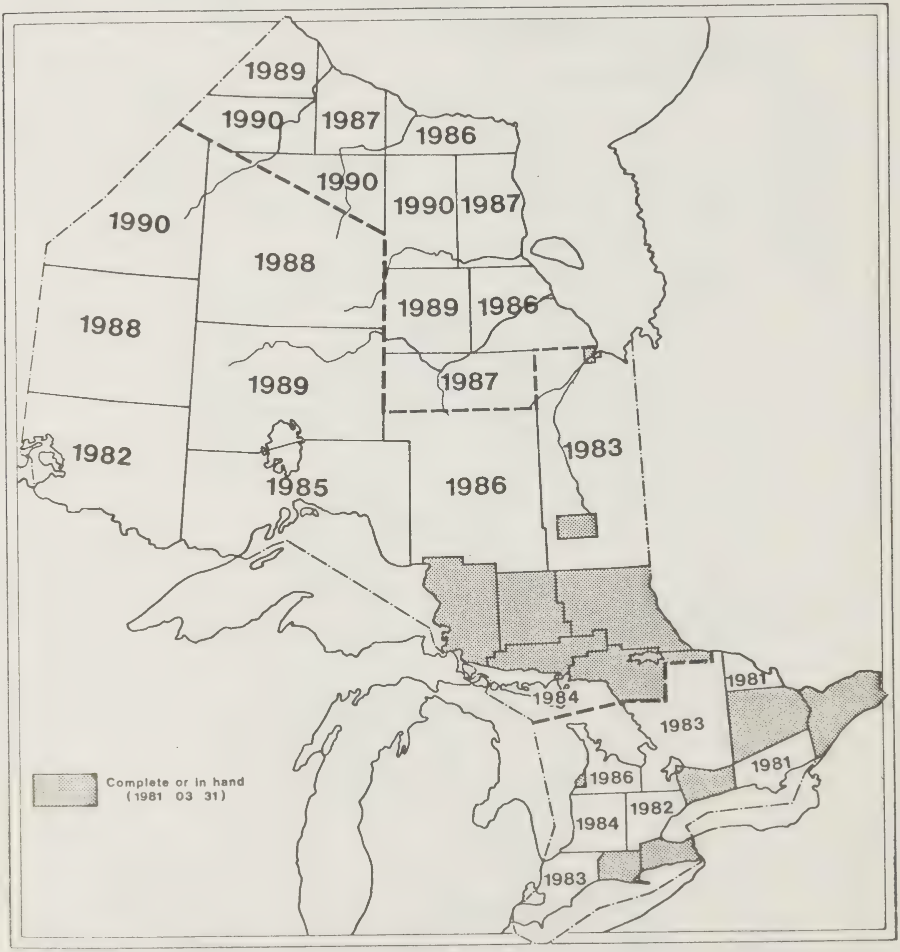
Slide 20: 1:20 000 Map With Outline of 1:2000

SEE SLIDE — Page 58

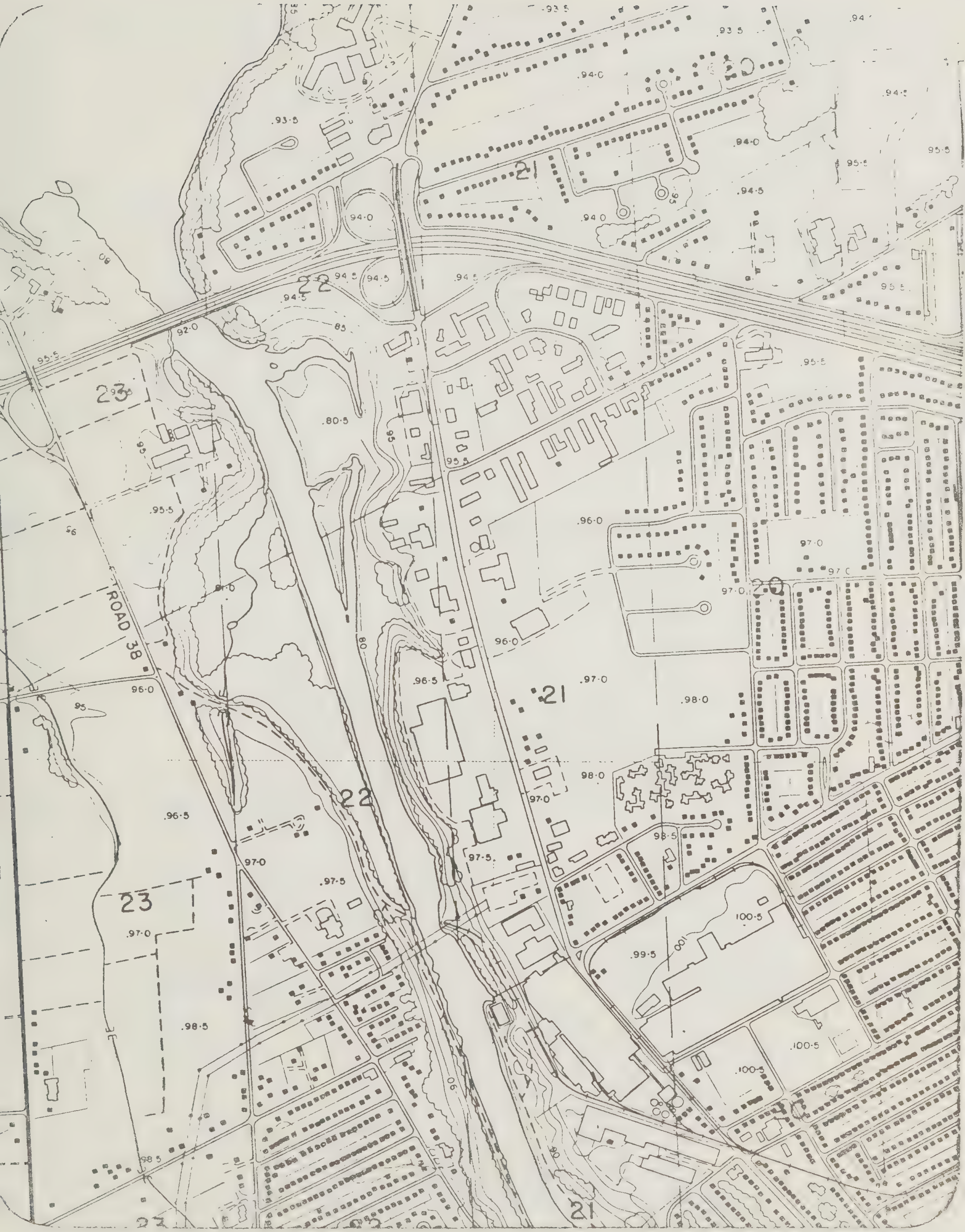
- *Northern Ontario; community of Spanish identified.*

: :

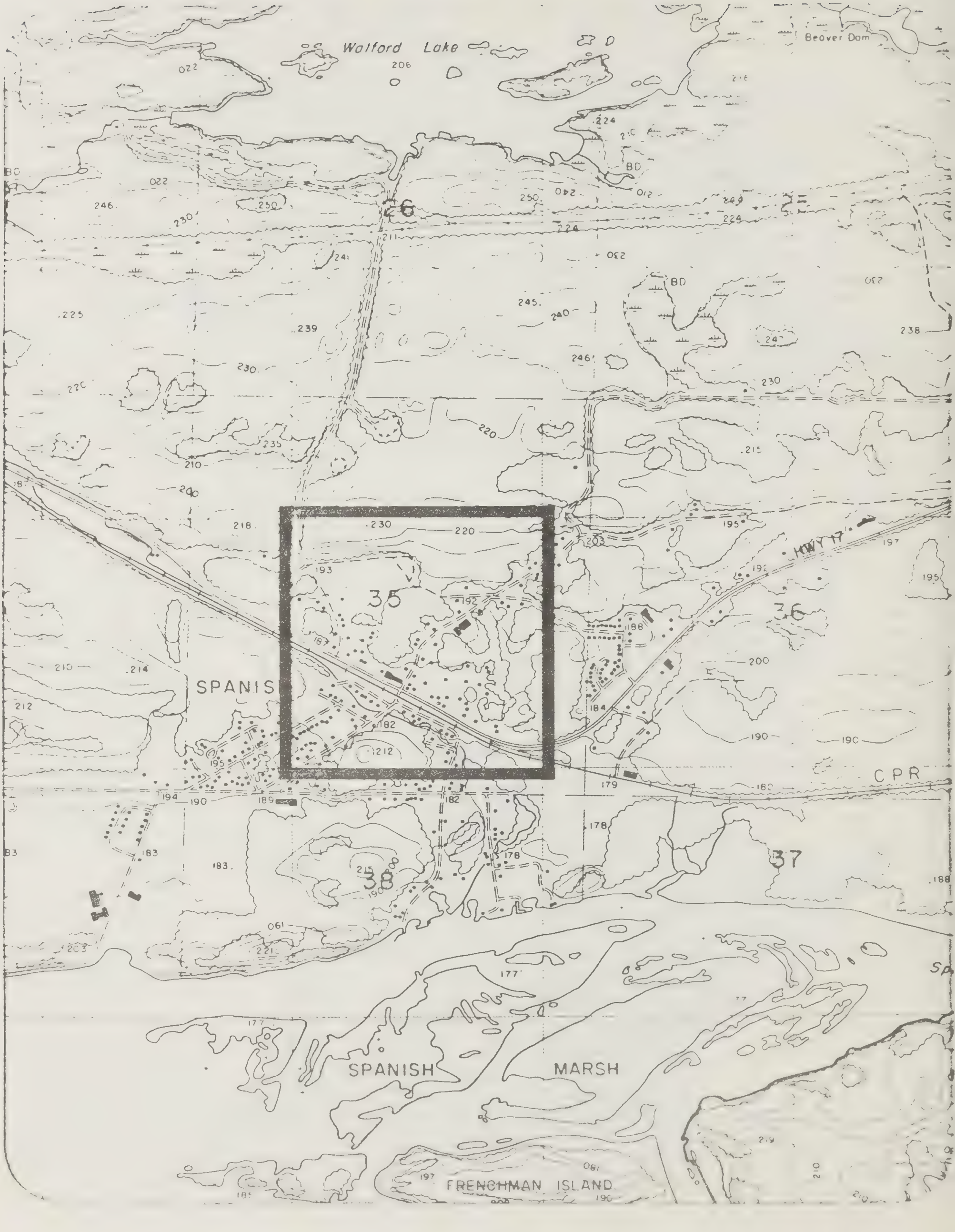
Mapping Priorities Determined And Approved At Standing Priorities Meeting January 1981
(Map production to commence in year indicated in blocks)



Slide 18



1:10 000 Slide 19


Walford Lake
Beaver Dam
HWY 17
SPANIS
CPR
SPANISH
MARSH
FRENCHMAN ISLAND
35
36
37
38
26

Slide 20

This is part of one of the 1:2000 maps in the area just outlined on the previous slide:

Slide 21: 1:2000

SEE SLIDE — Page 60

- *Spanish — part of one of the 1:2000 maps.*

: :

And this shows one of the uses of a 1:2000 map — the base map with a cadastral overlay. This urban, large-scale component of the program is undertaken under a cost-sharing agreement between a municipality and the Ministry of Natural Resources.

Slide 22: Cadastral Overlay

SEE SLIDE — Page 61

: :

Under this agreement we provide the municipality with a starter kit, which includes:

(a) horizontal monumented control on the perimeter of the limit of potential mapping, which can be defined by the municipality; and adjusted aerial photography and vertical control of the whole area;

(b) 1:2000 topographic mapping of the community's immediate needs, covering the built-up areas, and

(c) a sample cadastral overlay for one map sheet.

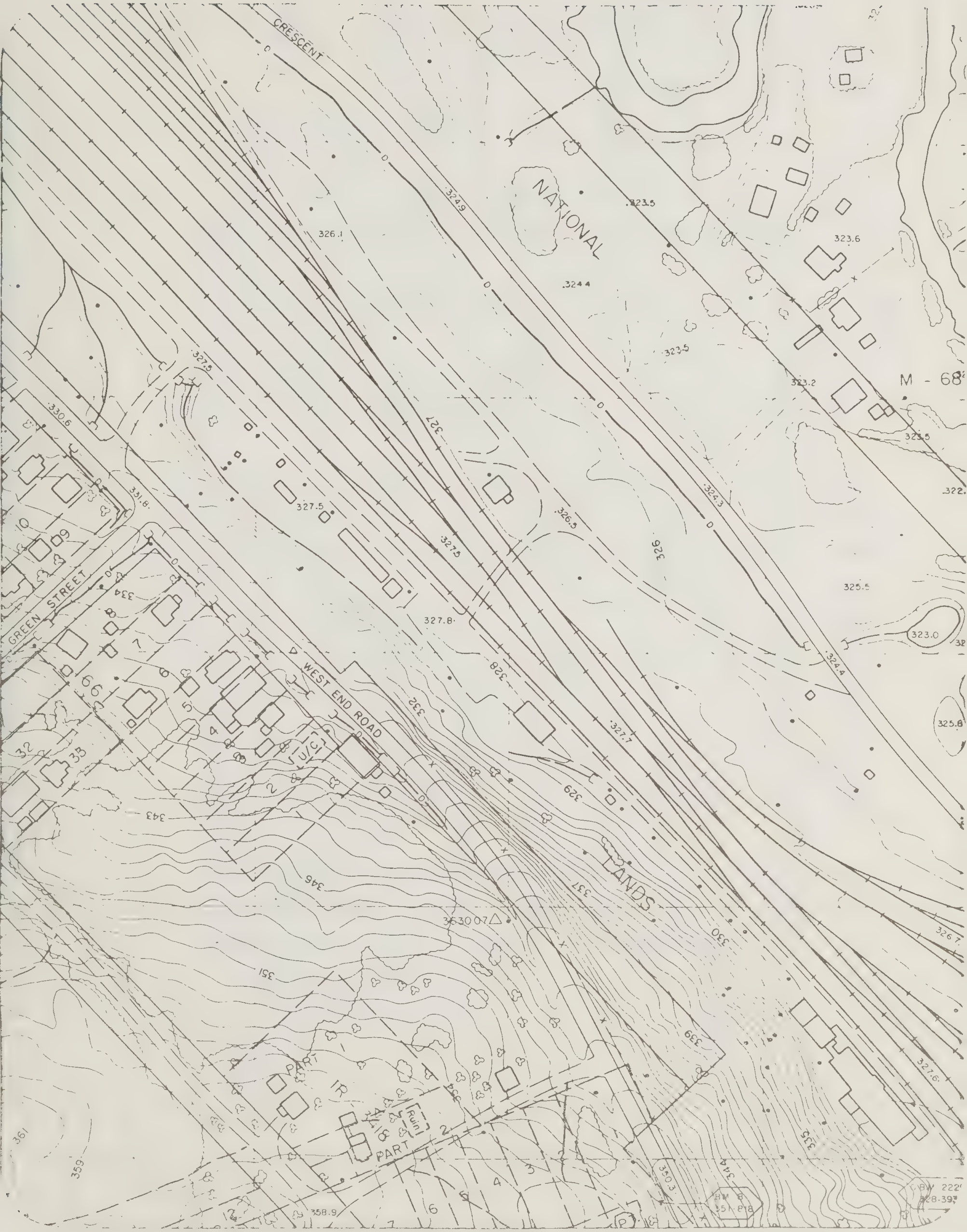
Slide 23: Community Starter Kit

SEE SLIDE — Page 62

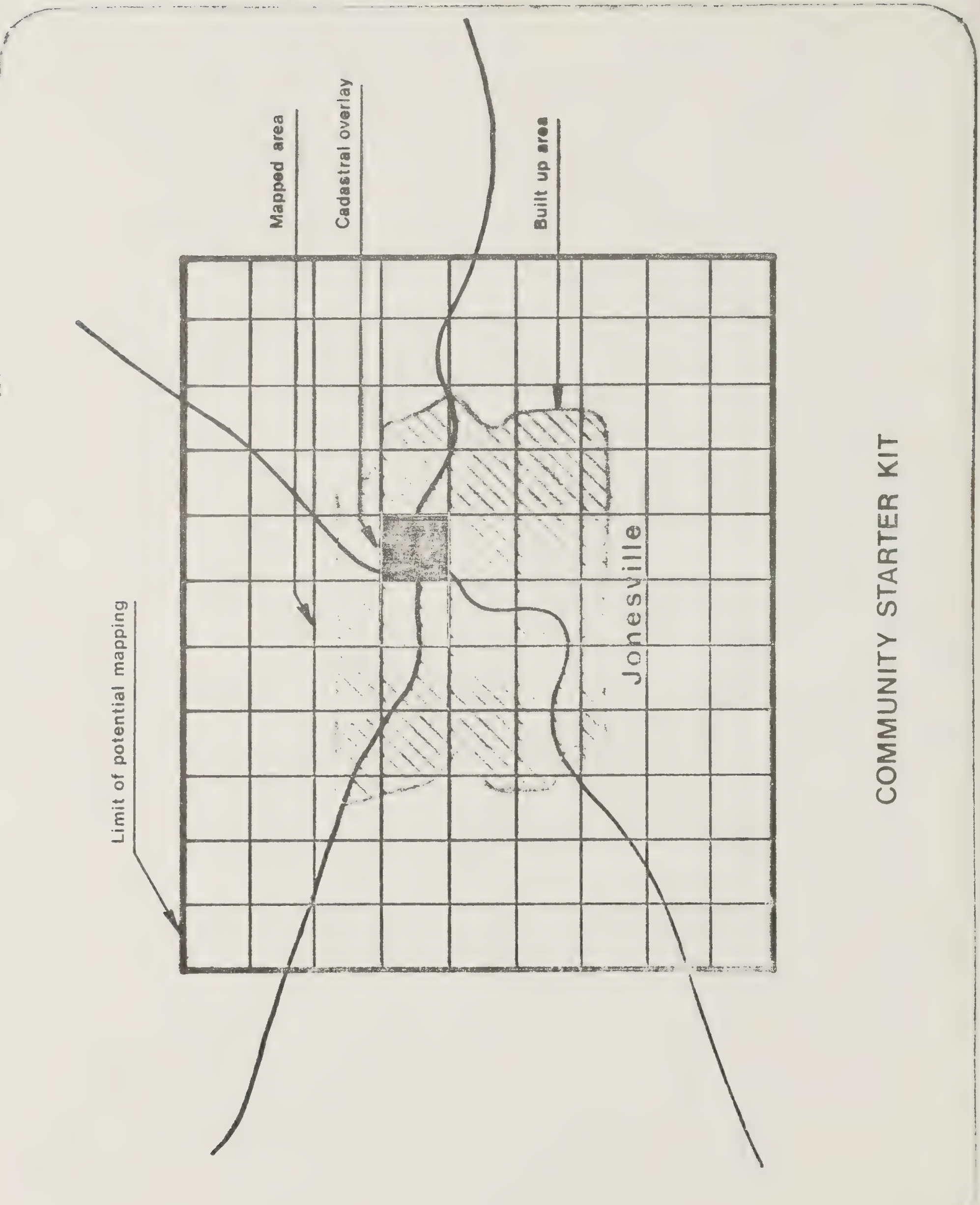
The municipality's share of the cost for all this is determined by the size of the community. Additional expenditures, for anything done after this package is complete, are the responsibility of the municipality.

: :

Slide 21


CRESCENT
NATIONAL
LANDS
WEST END ROAD
GREEN STREET
M - 68
PART
Ruin

Slide 22


Mapped area
Cadastral overlay
Built up area
Limit of potential mapping
Jonesville
COMMUNITY STARTER KIT

Slide 23

The 1:2000 mapping is, of course, used for many other purposes, and this gives some idea of what they are. I am sure that an enterprising Clerk of the Council can also find other uses for the maps!

Slide 24: Uses of 1:2000 Maps

USES OF 1:2000 SCALE MAPPING

- *Land use planning, general administration and severance application purposes;*
- *Preparation and amendment of zoning by-laws;*
- *Legal boundary surveys;*
- *Engineering study and preliminary design purposes for water, sewer, road, and drainage works;*
- *Locating or installing buried utilities;*
- *Subdivision layout design and development.*

: :

Which brings me to my last point. In the initial stages of program development, the intention was to establish a basic mapping system which would serve the interests of all sectors. This final slide shows some of the uses of all the products, among which I am sure you will be able to find some of particular interest to you.

Slide 25: Some Uses of OBM Products

GOVERNMENT — INDUSTRY — PUBLIC

- *Land and Resource Management*
- *Filing and Information Systems*
- *Real Property Registry*
- *Search and Rescue Systems*
- *Property Tax*
- *Engineering Services and Utilities*
- *Socio-economic Studies*
- *Electoral Records*
- *Geographical Referencing*
- *Flood Line Mapping*

: :

Thank you very much.

CHAIRMAN IVES: Thank you very much, Cy, for an update on what I understand to be one of the most fundamental programs in this geo-referencing effort. What I like about it is that it provides a hands-on product that I can go and touch and see and all of that. And as you pointed out, there is a display in the back corner of the room that outlines the basic mapping program.

Our next speaker is John Kerr, and I am sure he is someone that all of you are very familiar with judging by the number of people who came in and shook hands with him this morning. John is the Co-ordinator of Geographical Referencing at the Ministry of Natural Resources. He was a member of the Task Force on Geographical Referencing (TFOGR), and is the Executive Secretary of the ICOGR Committee that you heard about earlier this morning. He is also a member of one of the three technical committees that are working under the jurisdiction of the National Digital Mapping Standards Committee. It is in this capacity that he will be talking to us this morning, and I believe that what he is going to do is bring us an update on the activities of those three technical committees. John. (Applause)

MR. JOHN KERR: Thank you, Laura, and good morning.

REPORT ON NATIONAL DIGITAL MAPPING STANDARDS TECHNICAL COMMITTEES

MR. JOHN H. KERR
GEOGRAPHICAL REFERENCING, MINISTRY OF NATURAL RESOURCES

The growing use of digital maps and related graphic products has fostered the development of a variety of systems for producing them. Unfortunately, magnetic tapes containing digital maps that are produced on one system are rarely suitable for use on any other type of system. This incompatibility is a result of a variety of factors including the different ways in which tapes are formatted, features are named and coded, and the questionable or unknown quality of the digital product itself. The development, acceptance and use of standards in all these areas will do much to expedite the exchange of digital map data between different agencies. Towards this end the Canadian Council on Surveying and Mapping passed a resolution in 1978 which in effect directed the Topographic Survey Division of the Department of Energy, Mines and Resources (EMR) to create a mechanism for the formulation of standards for the exchange of digital mapping, including the storage and retrieval of digital map data involving federal, provincial and municipal governments, universities and the private sector.

In compliance with this resolution a planning meeting was convened by the Department of Energy, Mines and Resources in Ottawa in December 1978. That meeting was attended by representatives from all provinces and the Federal Government. The meeting constituted itself as a steering committee and established three technical committees for the purpose of preparing standards for:

(1) the classification of topographic features;
(2) topographic data precision, resolution and quality;
(3) electronic data processing as applied to digital topographic data.

Ontario has representation on each of these three national technical committees.

In April 1979 a permanent secretariat for the three technical committees was established in Ottawa to support the activities of the committees by preparing discussion papers, assembling comments, distributing minutes and other pertinent information. It also provided the link between the three committees.

The task of Committee-I was focussed on the development of a feature classification and coding system as well as a dictionary of terms describing clearly and unambiguously all topographical terms used in the classification. In developing the feature classification, Committee-I considered and accepted the notion of a single, uniform, national classification system for all topographic features which would be applicable regardless of the scale of representation. It also studied a variety of existing classification systems based on federal, provincial and municipal mapping specifications including related disciplines such as forestry, geology and land use in order to discern patterns of compatibility and areas of difficulty.

It is anticipated that many Canadian digital mapping systems now in existence will not replace their classifications and codes with the national standards. However, providing they can map their existing feature codes into the new classification, exchange of digital data will still be possible. The point is — in the absence of a standard, everyone will have to map their specific classification to and from everyone else's classification with whom they exchange data.

The classification developed by Technical Committee-I is open-ended in that new topographical features can be added in the appropriate category when required. Furthermore, topography is only one in a series of different disciplines. Other disciplines such as geology, agriculture, forestry, can create their own classifications and all these can, if desired, be included in a national classification of features and definition of terms which will serve to expedite the transfer of digital data.

The Topographic classification as developed has several levels. Level 1 groups all features into nine categories, these in turn are divided into sub-categories which are listed in Level 2; Level 3 contains the features themselves. The fourth level contains attributes. The nine categories into which the features are grouped, are:

LEVEL 1 (CATEGORY)

(1) Designated Area
(2) Building
(3) Structure
(4) Roadway and Railway
(5) Utility
(6) Delimiter
(7) Land Cover
(8) Hydrography
(9) Hypsography

The following nine slides give an indication of how the categories are divided into sub-categories and then into the features themselves:

Slide 1:

(Category) Level 1	*(Sub-Category) Level 2*	*(Feature) Level 3*	*(Attributes) Level 4*
Designated Area	*Agricultural Area*	*Farm/Ranch*	*Cattle Dairy Poultry etc.*
"	"	*Feed Lot*	
Designated Area	*Commercial Area*	*Shopping Centre Complex*	
"	"	*Yard*	*Coal Junk Lumber etc.*
	etc.	*etc.*	

Slide 2:

(Category) Level 1	*(Sub-Category) Level 2*	*(Feature) Level 3*	*(Attributes) Level 4*
Building	*Agricultural Bldg.*	*Barn*	
"	"	*Granary*	
"	"	*Greenhouse*	
"	"	*Stable*	
Building	*Commercial Bldg.*	*Unspecified*	
"	"	*Bank*	
	etc.	*etc.*	

Slide 3:

(Category) Level 1	(Sub-Category) Level 2	(Feature) Level 3	(Attributes) Level 4
Structure	*Agricultural Structure*	*Corn Crib*	
"	"	*Feeder Station*	
"	"	*Silo*	
"	"	*Stock Pen*	
"	"	*Wind Pump*	
Structure	*Commercial Structure*	*Billboard*	
"	"	*Fuel Pump*	*Diesel* *Gasoline*
	etc.	*etc.*	*etc.*

Slide 4:

(Category) Level 1	(Sub-Category) Level 2	(Feature) Level 3	(Attributes) Level 4
Roadway or Railway	*Roadway*	*Road (Gravel Divided)*	*In Use-1 Lane Each Way* " " *-2 Lanes Each Way* " " *-3 Lanes Each Way* *etc.*
"	"	*Road (Paved Divided)*	*Abandoned* *In Use* *In Use-Elevated* *etc.*
"	"	*Road (Paved Undivided) etc.*	*Abandoned* *In Use-Elevated* *In Use-Elevated-One Lane* *etc.*
Roadway or Railway	*Through Rail Line*	*Rail Line (Double Track)*	*Abandoned* *Light Rail Transit-Surface* *Proposed* *etc.*
"	"	*Rail Line (Monorail)*	*Abandoned* *Light Rail Transit* *etc.*
"	"	*Rail Line (Multiple Track)*	*Abandoned* *Light Rail Transit* *etc.*
Roadway or Railway	*Associated Feature*	*Crossing Gate (Railway)*	
"	"	*Cut (Railway)*	
"	"	*Switch (Railway)* *etc.*	

Slide 5:

(Category) Level 1	(Sub-Category) Level 2	(Feature) Level 3	(Attributes) Level 4
Utility	*Utility*	*Antenna*	*TV* *Radio* *Microwave*
"	"	*Cable*	*Electrical* *Telephone* *Telegraph*
Utility	"	*Conduit*	*Electrical* *Telephone*
Utility	"	*Line* *etc.*	*Electrical* *Telephone* *Primary* *Secondary* *Tertiary*
Utility	*Utility*	*Manhole*	*Electrical* *Heating* *Sewage* *Sanitation* *Storm* *etc.*
Utility	*Utility* *etc.*	*Pipeline* *etc.*	*Hot Water* *Heating* *Natural Gas* *Steam* *etc.*

Slide 6:

(Category) Level 1	(Sub-Category) Level 2	(Feature) Level 3	(Attributes) Level 4
Delimiter	*Administrative & Political*	*Boundary*	*Agriculture Land Reserve* *Census Division* *Environment Region* *etc.*
Delimiter	*Administrative & Political* *etc.*	*Boundary* *etc.*	*City* *County* *District* *etc.*

Slide 7:

(Category) *Level 1*	*(Sub-Category)* *Level 2*	*(Feature)* *Level 3*	*(Attributes)* *Level 4*
Land Cover	*Woodland*	*Burn*	
" "	"	*Clear Area*	
" "	"	*Cut Line*	
" "	"	*Firebreak*	
" "	"	*Grove*	*Coniferous* *Deciduous*
		etc.	
Land Cover	*Arable/Cultivated Land*	*Crop Land*	*Grain* *Root Crops*
" "	"	*Market Garden*	
	etc.	*etc.*	*etc.*

Slide 8:

(Category) *Level 1*	*(Sub-Category)* *Level 2*	*(Feature)* *Level 3*	*(Attributes)* *Level 4*
Hydrography	*Watercourses*	*Aqueduct*	
"	"	*Canal*	*Navigable* *Non-navigable* *Irrigation*
"	"	*Channel* *etc.*	*Navigable* *etc.*
Hydrography	*Inland Water Bodies*	*Dugout*	
"	"	*Flooded Land*	
"	"	*Lagoon*	
"	"	*Lake*	*Alkaline* *Dry* *Indefinite*
	etc.	*etc.*	*etc.*

Slide 9:

(Category) Level 1	(Sub-Category) Level 2	(Feature) Level 3	(Attributes) Level 4
Hypsography	*Relief*	*Contour, Land*	*Approximate Auxiliary etc.*
"	"	*Contour, Glacier*	*Depression Index etc.*
"	"	*Contour, Bathymetric etc.*	*Intermediate Interpolated etc.*
Hypsography	*Landform*	*Alluvial Fan*	
"	"	*Bench*	
"	"	*Cape etc.*	

Although codes have not yet been assigned to the features in the classification it is anticipated they will be established first by the feature name followed by attributes and subsequently the category and sub-category. The next slide illustrates this:

Slide 10:

Level 3	Level 4	Level 5	Level n	Level 1	Level 2	Local Use
Feature	*Attribute*	*Attribute*	*Attribute*	*Category*	*Sub-Category*	*(Attribute not in classification)*
Manhole	*Sanitation*	—	—	*Utility*	*Utility*	*Plan 710 No./12*

The dictionary of topographic terms is also nearing completion. It contains in alphabetical order all the topographical features or terms in the classification accompanied by a description of the meaning of each. Following is a sample taken from the first page:

Abandoned: An adjective referring to a man-made facility no longer being used for its original purpose, as in "abandoned mine". The term may be used with a symbol, e.g. beside an airport symbol, or with a place name, e.g. ELMA (abandoned).

Accessway:	A road giving access to a facility, but not a through road.
Aerial Cableway:	A transportation device consisting of an endless cable supported on towers. Cars attached to the cable are used for moving people or materials.
Aerodrome:	An alternative term for airport, etc., now used in Canada only in the legal sense to indicate a landing facility licensed by DOT.
Air Beacon:	A distinctive light (flashing, rotating or other) used for the guidance of aircraft.
Airfield:	Landing facility for aircraft, usually without a passenger terminal. The services offered for aircraft supply and maintenance are substantially less than those of an airport (q.v.). Airfields usually have legal limits which are delineated at 1:50 000 and larger scales.
Airport:	Landing facility for aircraft usually with more than one runway and with facilities for handling passengers and air freight and for servicing aircraft. The legal limits of the airport are usually delineated at map scales of 1:50 000 and larger.
Airstrip:	Landing facility for aircraft consisting of a single runway which is usually of gravel construction. Airstrips rarely have a boundary fence or a delineated legal limit.
Alkali Lake:	A lake containing a high proportion of soluble salts. Such lakes are often found in a depression and have no natural outlet.
Alley:	A narrow lane between buildings, especially through the middle of a city block, giving access to the rear of buildings.
Alluvial Fan:	The alluvial deposit of a river or stream where it issues from a gorge into an open plane. See also delta.
Ammunition Dump:	A military installation used for the storage of explosives and other warlike stores. Ammunition dumps are normally fenced, and the legal limit is delineated on map scales of 1:50 000 and larger.
Amusement Park:	An area where entertainment is provided by game concessions, rides, etc.

Slide 9:

(Category) Level 1	*(Sub-Category) Level 2*	*(Feature) Level 3*	*(Attributes) Level 4*
Hypsography	*Relief*	*Contour, Land*	*Approximate Auxiliary etc.*
"	"	*Contour, Glacier*	*Depression Index etc.*
"	"	*Contour, Bathymetric etc.*	*Intermediate Interpolated etc.*
Hypsography	*Landform*	*Alluvial Fan*	
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Feature	*Attribute*	*Attribute*	*Attribute*	*Category*	*Sub-Category*	*(Attribute not in classification)*
Manhole	*Sanitation*	—	—	*Utility*	*Utility*	*Plan 710 No./12*

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Amusement Park:	An area where entertainment is provided by game concessions, rides, etc.

Technical Committee-II concentrated on reviewing existing mapping standards and digital data acquisition equipment in order to develop a procedure for evaluating the quality of digital topographic data. It also defined the contents of a parameter block which would provide a potential user of digital topographic data with an idea of the quality of the data with respect to accuracy, precision, resolution and timeliness.

The Committee studied each step in the digital map making process from ground control to putting the final map on magnetic tape. It then isolated the factors involved in each step of the process which could contribute to a loss in accuracy. The Committee then grouped these factors into blocks and developed a set of rules whereby each digital map producer could evaluate the accuracy of the data in each of his files. The Committee has recommended that all producers of digital map data should abide by the same rules for this evaluation and include the results in a "parameter block" on the tape containing the map. In this way anyone receiving the digital map would know how accurate it is.

Because of the many parameters which can affect the accuracy of the final product including ground control, photography, aerial triangulation, stereo model orientation, compilation, drafting, printing, digitizing equipment and procedures used — the Committee recommended the parameter block include:

(1) Name of agency generating the information.

(2) Name of agency requesting the information.

(3) Free text of general information related to the particular data tape that has any peculiar or particular features.

(4) Data Processing code information.

(5) Map sheet identifier.

(6) Coordinate system used.

(7) Map zone, if UTM, or other reference if local coordinates.

(8) Units used for data storage.

(9) Spheroid name and contents.

(10) Horizontal and vertical datum.

(11) Minimum and maximum coordinates and evaluation.

(12) Coordinates of vertices of a polygon which approximately describes the area covered by the file with "N" points not to exceed 50.

(13) Number of overlays in the map file.

(14) Coded array of feature classes on each topographic data set.

(15) Scale of photography from which data was compiled.

(16) Description of stereo compilation equipment (least count and resolution).

(17) Scale of map if digitized from existing graphics.

(18) Description of digitizing equipment used, least count and manufacturers' equipment resolution.

(19) Positional accuracy on ground of data recorded.

(20) Precision.

(21) Method of determining positional accuracy.

(22) Resolution of any features where generalization or sampling has been used.

(23) Date of culture validity.

(24) Date of photography used.

Technical Committee-IIs review of digital data acquisition equipment included manual digitization, semi-automatic digitization, (scanning) and direct digitization from photogrammetric instruments.

Technical Committee-III is responsible for the development of standards for the application of electronic data processing technology to digital topographic data. The major portion of Committee-IIIs work was originally intended to take place subsequent to the completion of the feature classification system by Committee-I and the definition of the accuracy standards by Committee-II, however considerable progress has already been made on an "exchange" format.

Committee-III has selected the standard ½", 9 track, magnetic tape as the most suitable medium of exchange for the foreseeable future. It is also in favour of adopting the "superstructure" concept proposed by the Landsat Ground Station Operators Working Group (LGSOWG). This provides documentation and directory facilities for the contents of the tape and replaces standard tape labels and/or accompanying paper notes. The selection of the superstructure concept is significant on two counts. First it makes use of an existing standard, secondly it recognizes the potential importance of remote sensing data to mapping programs. Its adoption will help to ensure continued compatibility with, and expedite the exchange of data between the mapping and remote sensing communities.

A subset of the superstructure concept is presently used for the exchange of digitized polygon data by the Canada Centre for Remote Sensing, Statistics Canada, Environment Canada and Agriculture Canada.

Committee-III is also developing the codes for topographic features in cooperation with Committee-I. This is being accomplished through the exchange of minutes from committee meetings and the attendance of one of the members from Committee-III at Committee-I meetings when required.

While the basic goal of Committee-III is to develop a standard exchange format it should be realized that the standard is not being designed to meet specific objectives of any individual organization and therefore may never be used as the internal format of any organization. Rather, organizations will more probably map or translate their data (both attribute and positional) into the standard exchange format in order to transfer it to others. Likewise most organizations will translate from the standard exchange format into their own internal format when receiving data from others.

In addition to the foregoing, a subcommittee of Committee-III has produced a draft on minimum digitizing standards for point, line and area

features. These include such things as the method of positional representation, the geometry of features and their classification and the minimum requirement for digitizing certain features. The subcommittee's proposal is under review and consideration at the present time by Committee-III.

It is anticipated that the work of all three technical committees will be finished this year in time to report to the CCSM this Fall. If there are any questions, I will be glad to attempt to answer them at the question period scheduled for this afternoon. Thank you. (Applause)

CHAIRMAN IVES: Thank you very much, John. You managed to keep us right on time and you did an excellent job of summarizing the work that those committees have been doing — particularly when you were not on two of the three technical committees. I am sure we are all interested in and are awaiting the Fall report. John will be back with us this afternoon to give us some further words of wisdom.

It is my understanding that lunch will now be served — it is a buffet lunch and it is in exactly the same room where you had the coffee this morning. Obviously all of us will not be able to stand in that room together, unless you want to get really cosy. So I would like to suggest that you pick up your lunch and then bring it back into this room and take advantage of the tables and chairs here. With that, will you please try to be back by one o'clock, so we can hear the afternoon presentations.

AFTERNOON SESSION — TUESDAY, MARCH 10th, 1981

CHAIRMAN IVES: I hope you enjoyed that lunch as much as I did. There are a couple of announcements that I have to make before we get going this afternoon.

First of all for anybody who did not register. There are some name tags that have not been picked up. If you have pre-registered your name tag is still on the board outside the north entrance; you are welcome to pick it up whenever it is convenient for you. There are also some people

who did not pre-register. Of course you are welcome, but we would like to get a record of your name and the agency you are with. I believe, once again, that there is a list at the north entrance for this information. If you would be so good as to write down your name and agency, and pick up a blank name tag and fill it in so that people can identify who you are, we would appreciate it.

The other thing was that somebody asked me if there were any more ash-trays . . (chorus of no, no). I have to confess that I am a non-smoker, and I do not appreciate your needs. (Applause) However I also found out, and you might accuse me of being biased, that the caretaker does not have enough for the whole floor, let alone this room. So I suggest you use one of the paper cups or re-use your coffee cup. OK, I think that is all in the way of announcements.

This afternoon to get us going after lunch, which is a very bad time, we have a dynamic duo, and I am not referring to Batman and Robin, for those of you who are old enough to know who they are. Instead we have John Kerr and Jim Linders who will sort of be doing a show together. My understanding is that John will be starting off the presentation and that Jim will follow it up. I have already introduced John to you and I think a lot of you probably know Jim as well. Jim did not give me any material with which to introduce him until this morning, about five minutes before the Seminar. I do not know if he was leaving that up to my imagination, which I warned him once already is a very dangerous thing to do. However, he did give me a sheet of paper about some of his former activities. I think I will just say that since 1977 he has been the Chairman of the Department of Computing Information Sciences at the University of Guelph. He gave me a delightful list of all the organizations that he is a member of, but they are all in acronym form, and to be perfectly honest I do not have a clue what they stand for, so with that I would like Jim and John to start off the afternoon.

MR. JOHN KERR: Thank you Laura. So that we are all in phase, I would like to define what we mean by geographical referencing.

GEOREF SYSTEM DEVELOPMENT UPDATE

MR. JOHN H. KERR,
GEOGRAPHICAL REFERENCING, MINISTRY OF NATURAL RESOURCES

Geographical referencing is the process of recording in a systematic and retrievable fashion the unique position or location on earth where something happened or is located.

The aim of the Interministerial Committee on Geographical Referencing and the Geographical Referencing Section of the Ministry of Natural Resources is to work towards the implementation of a comprehensive geographical referencing system which will permit visual and rapid geographical correlation of the physical properties, resources, legal status and use of the land in the Province of Ontario. Towards this end we are developing and pressing for the adoption of a totally integrated set of geographical referencing standards. Ontario is producing a systematic series of accurate base maps, we are developing general purpose computer routines for handling and manipulating spatial data and we will be designing and working towards the implementation of an integrated, distributed geographical referencing data base system which will facilitate the retrieval and correlation of positionally related information.

To date several things are in place. As stated earlier by Mr. Foster on behalf of the Honourable James Auld, the UTM is the official geographical referencing grid for Ontario. A standard series of grid cells is defined. Specifications and guidelines (for horizontal control surveys) (OS79) and (OG79) have been prepared and published. COSINE, the Provincial horizontal control survey data bank, is almost complete and several thousand stations are on tape ready for implementation. Cy Osborne has already told you where the Ontario Basic Mapping program is at and Jim Linders will be telling you where we are with respect to developing general purpose computer routines for handling positionally related data. Before he does, I would like to mention for those of you who don't already know, that the Ministry of

Natural Resources entered into an agreement with the University of Guelph in January, 1979, for the purpose of having Dr. Linders and his GEOREF team develop a pilot system which would permit us to digitize OBM maps and several types of thematic maps.

ICOGR provided input into the development of the specifications which in addition to a digitizing capability included the requirement for a variety of computer routines for handling and manipulating both feature and attribute data. Some of the products produced at the University of Guelph, under the agreement, are on display.

When the basic pilot production system is ready the Ministry of Natural Resources intends to implement it at Queen's Park; test, debug and refine it through limited in-house digitization of OBM maps and if it is found suitable and practical, turn it over to the mapping industry for the digital production of OBM maps. We are not looking for a system which permits us to simply digitize, plot or display basic map data, but one which permits subsequent integration of thematics in digital form. It is important that this integration is possible because of the need for different applications to have a single representation of the basic map features. It is obvious that if every different application had to digitize the basic map features themselves, in time there would be a tremendous duplication of effort.

Not so obvious, but more important, is the fact that no two applications would digitize the same base map features identically and thus correlation of different thematics becomes very difficult and costly, if not impossible.

I would now like to ask Dr. Linders to give us an update on where the GEOREF development at the University is at. (Applause)

DR. JAMES LINDERS: Thank you John, and thank you Laura.
First of all let me say that I tried to develop a set of foils and topics that are on a relatively general level, primarily because I feel that it

might be more meaningful to communicate at a general level with a group of this size with such diverse experiences and training. Then, for those who feel that they would like more detailed information, I certainly am available for whatever time is necessary this evening and tomorrow, and I can go into more details as required. There is also the question period during which I will go into whatever level of detail is requested.

Obviously it is impossible to cover the full scope of the activities in the allotted time; the fact is, however, I am sort of getting used to doing these presentations to a variety of different audiences. After a while it gets to be second nature; in fact when I was preparing this talk I wondered, maybe I am the wrong guy to be doing this — perhaps it should have been John Kerr. Which reminds me of a story about a chap who was a distinguished speaker who was frequently asked to give the same talk over and over again. The speaker would invariably invite his chauffeur to come in with him and the chauffeur would sit and listen; they also talked about the subject frequently between speaking engagements. In time the chauffeur became very conversant with the subject matter. One day the speaker suggested that the chauffeur should do the presentation and he — the speaker — would sit in the audience. As you might expect, the talk went well, so did the question period until somebody asked a very profound question. The chauffeur, masquerading as the speaker, reeled a bit, then after regaining his composure, replied: "That question really isn't as difficult as it sounds. As a matter of fact, the answer is so obvious that I am sure even my chauffeur, who is in the audience, can and will be pleased to answer it." (Laughter) Next year, I am suggesting, John, that I will be in the audience. (Laughter)

If I start getting too deep or skim over something — and I have a habit of doing this at times — wave flags or do something and I will try to slow down, get back on track, or discuss more of that particular topic as we proceed.

Before I can talk about an update, I must tell you what GEOREF is and I will try and relate it to what Ruben said this morning, because, as I said to Ruben later, we are soul brothers, we are speaking the same language. It is now a question of trying to convince other people that this is a viable philosophy for land mass information systems.

GEOREF SYSTEM DEVELOPMENT UPDATE

DR. J. G. LINDERS
DEPARTMENT OF COMPUTING AND INFORMATION SCIENCE
UNIVERSITY OF GUELPH

Introduction

The GEOREF system is a conceptual framework for the orderly storage, management, and retrieval of positionally related land mass information. The basic motivation for developing such a system has been to provide a single consistent data base environment within which all users of land mass information can share resources, both data and function.

The development contract was given to the Department of Computing and Information Science at the University of Guelph to implement a system to operate on a mini computer. The current status of the system is described in this paper.

GEOREF DEVELOPMENT CONTRACT

The development contract for the GEOREF system was to provide a pilot production system which would be capable of realizing many of the objectives of geographical referencing as identified by the Interministerial Committee on Geographical Referencing (ICOGR). The contract called for both the development of system capability as well as a number of specific products.

Over and above the basic system capability a number of specific application areas were identified. These include:

1. A basic system capability for the production of Ontario Base Maps (OBM).
2. The creation of Forest Resource Inventory (FRI) maps.
3. The development of a system capability for the automatic production of lake bottom contour maps, from shoreline data and transect information for any lake.
4. Land use planning maps.
5. Large scale plans for use within the MCCR mandate (land registry).

Each of the above capabilities was to be a subset of the overall system capability.

The contract called for a number of other details such as the development of this system on a mini computer wherever possible. As well, a primary motivation for the contract was to evaluate the cost effectiveness of using digital techniques for the production of products which are currently made manually.

APPROACH TO SYSTEM DEVELOPMENT

The development of this system has been motivated by a number of factors, some of these are technological while others are related to operational factors such as the need to share data with users from other mandate areas. The need for a set of common standards and the requirements for timely and updated information have been foremost in driving this development. In essence the GEOREF system has been an outgrowth of the development in automated mapping at the Surveys and Mapping Branch of the Department of Energy, Mines and Resources in Ottawa. This system progressed from a basic graphics system to an information system, however, it was primarily confined to small scale mapping. The mandate as seen from the provincial perspective is not only for graphical products but for information services comparable to those currently in place within various ministries. As well there is a desire to provide a conceptual framework from which new services and products can be developed in an orderly and consistent manner.

The realization of the georeferencing system has been achieved through the exploitation of a number of digital technologies including data base technology, computer graphics, information retrieval, artificial intelligence, etc. Each of the above areas has contributed towards GEOREF's development and provides a framework from which GEOREF can capitalize on future development in these areas.

GEOREF is essentially a data base system in which a capability is provided for both the orderly storage and management of information as well as the definition and utilization of a number of specific functions related to the operation of the data base. A custom data base

management system known as the "File Manager" was used for catering to the specific requirements of georeferencing information. This data base management system is essentially an extension of the capability found within the Ottawa system for automated cartography. The extensions which had to be provided were specifically for dealing with other levels of information handling which are unique to thematic applications and larger scale mapping. A variety of structuring problems are found within the scope of large scale mapping which are not present within the more conventional smaller scale mapping. The use of the data base management system provides a standard for all GEOREF users to not only manage their information but to follow prescribed conventions as laid down by other standards bodies.

GEOREF has been an ongoing development. At each stage in this development there has been a considerable amount of learning based on the experience gained to date. This has invariably meant the enhancement of individual components to reflect the needs of specific application areas. Every attempt has been made to generalize products which can be molded to the needs of specific application areas by the user himself without the requirement of the computer scientist in this process.

The major emphasis on the system has been the deployment of generic products. For example, within the data collection process it is clear that no single data collection system will provide the needs of the community of users for the present and envisioned for the future. Each user has his own unique data requirements and must interface to the system in a manner which relates specifically to his own application areas. Some of these products are described in this report, specifically the data collection system as well as other data management capabilities.

SYSTEM CONFIGURATION

The system structure used at the University of Guelph to implement the basic georeferencing system includes the following hardware configuration:

1. PDP11/34 CPU with 256 Kbytes of main memory.
2. Magnetic tape drive and controller.
3. Two large 300 megabyte disk drives.
4. Two RK05 disk drives (total 15 megabytes).
5. Eighteen asynchronous line interfaces for terminals.
6. Floating point unit.
7. Cache memory.
8. DQ11 synchronous line interface.

This processor was used for the basic system development and stores all of the programmes used within GEOREF.

A second processor was used for handling the data collection devices. At present this involves a single large digitizing table 42" x 60". Because of the real time data requirements it was not possible to put the digitizer directly on the larger PDP11 without degrading the performance of the other users on the system. The original system is used not only for GEOREF but for student assignments as well.

There is also an offline plotter, namely a Calcomp 748 large flatbed plotter. This plotter is capable of producing high quality graphics as well as scribes which are required in the cartographic process. A Tektronix 4027 colour display is attached to the large PDP11/34 through one of the asynchronous ports. A smaller digitizer of size 22" x 22" is also available for use on either system. This is a portable device and is used specifically for editing of smaller graphics such as the OBM base maps.

It must be appreciated that the above environment is one that was readily available at the University of Guelph and represents the specific enhancements necessary for handling the GEOREF project. Specifically the following resources are required in order for GEOREF to operate effectively:

1. A minicomputer CPU with large main memory. GEOREF will run using the 16 bit CPU, however, it has been found expedient to consider some of the newer 32 bit minicomputers specifically because of the larger address space. The cost of a

typical CPU with main memory of 256 Kbytes is approximately $30,000 in terms of the current technology. However, similar hardware exists in the form of microcomputers with comparable capability at costs of approximately $10,000 (these are deficient, however, in terms of available software).

2. Secondary storage devices. A large amount of secondary storage is required not only for maintaining system programs, but specifically for storage of large map files. The current technology provides large disk drives of the order of 150-300 megabytes for less than $20,000.

3. Computer graphics hardware. A basic capability is required for reproduction of line graphics, specifically plotting devices. As well, a capability is necessary for a display of intermediate graphics on a display screen. The cost of display screens and plotters is in the range of $25,000.00 up.

4. Digitising devices. Encoding of graphic information in terms of machine readable format is achieved through a digitiser. For the current technology these devices are less than $20,000 each for large scale tables.

The operating system used at the University of Guelph to develop the GEOREF system was based on the UNIX system developed at Bell Laboratories in the United States. This software was used primarily because of its availability at the University of Guelph and its high reliability. The system is user-oriented and has considerable flexibility without demanding much of its users. As well, all of the system programs were developed using the programming language C which is found within UNIX. All application programmes were written in Fortran wherever possible. There is no assembler code within the total GEOREF system. A basic requirement of the system was to attempt to achieve the greatest degree of portability possible. Since all the programs are written in a high level language, namely C and Fortran, the maximum portability is achieved. The dependence on the operating system has been minimized and wherever this has been necessary standard system calls have

been used. No special operating system software was developed and every attempt has been made to remain with current technology and practices.

The GEOREF system makes heavy use of libraries wherever possible. In the initial stages some specific graphics software was developed for GEOREF. However, because of the inherent pitfalls of maintaining such an unnecessary capability it was decided to revert back to the libraries provided by various manufacturers including Calcomp, Tektronix, etc. Another underlying philosophy of GEOREF is to develop standard libraries of user functions which are shared within the community of users, specifically, libraries for map projections, map utilities, geometry, etc.

The design objectives of the GEOREF system were to provide a modular system capability which would be readily transported to other users and hopefully other environments with minimal effort.

PROJECT DETAILS

During the life of the original georeferencing contracts a number of application areas were investigated and developed. These include the capability for storing and managing the basic OBM maps as well as the integration of a number of related thematics with the base. It was not always possible to provide the necessary level of integration. The experience gained from the various exercises identify the actions which must be taken in order to realize the objectives of a comprehensive georeferencing data base. Each of the tasks will be described in summary form.

OBM MAPS

The basic requirement for a georeferencing system is to have a systematic underlying series of maps which constitute the logical partitions of the data base. For the georeferencing project to be used within the Province of Ontario this series is intended to be the OBM base maps. Within the system environment the data base is partitioned into a number of physical files to each of which corresponds the infor-

mation associated with a single base map. At the logical level, however, the user need not be aware of the partition boundaries, and in fact these boundaries are transparent to him. Hence any feature which traverses a map sheet boundary requires that the data be accessed from two separate files. The details of this are managed directly by the system and are not of concern to the end user.

The approach to building a digital base of OBM maps is to capture the data from the compilation manuscripts as provided by various photogrammetric contractors. This data is digitized and enhanced with suitable information so as to provide a base from which the current OBM maps can be derived on demand.

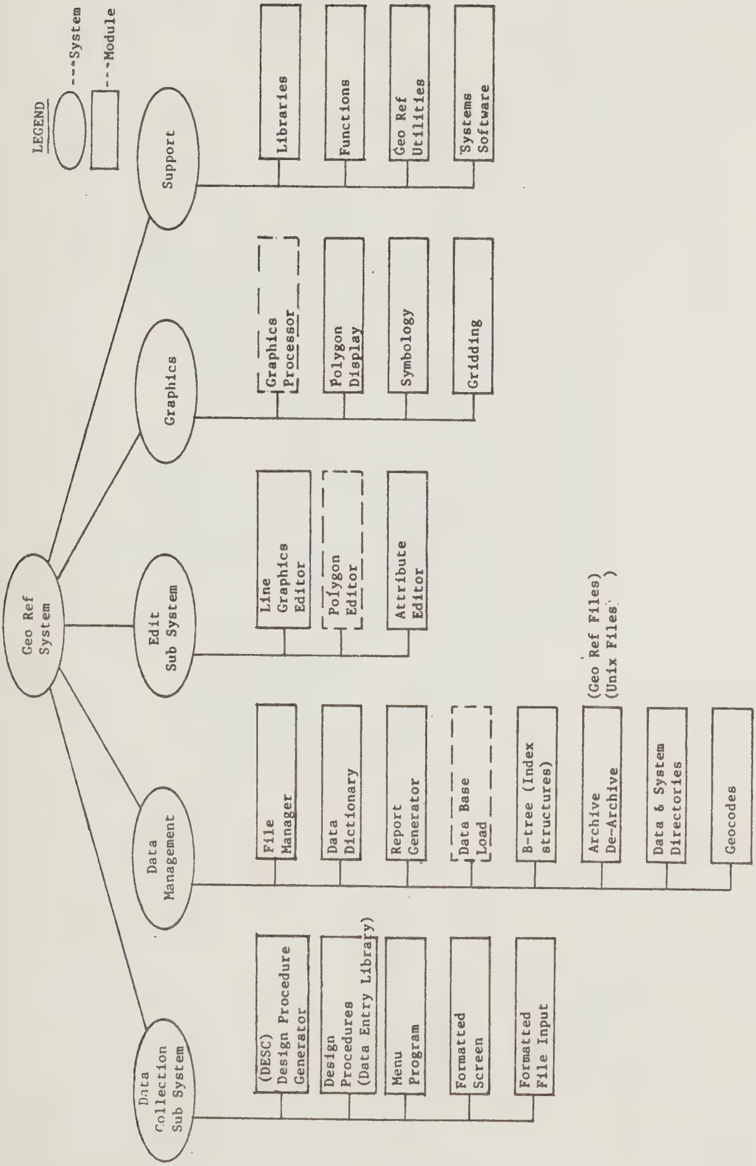
In order to meet the requirements for digitial mapping, specifically for the OBM system, a number of specific capabilities were developed. These include:

1. A specific set of design procedures for the orderly and consistent collection of various levels of data from the OBM compilation manuscripts.

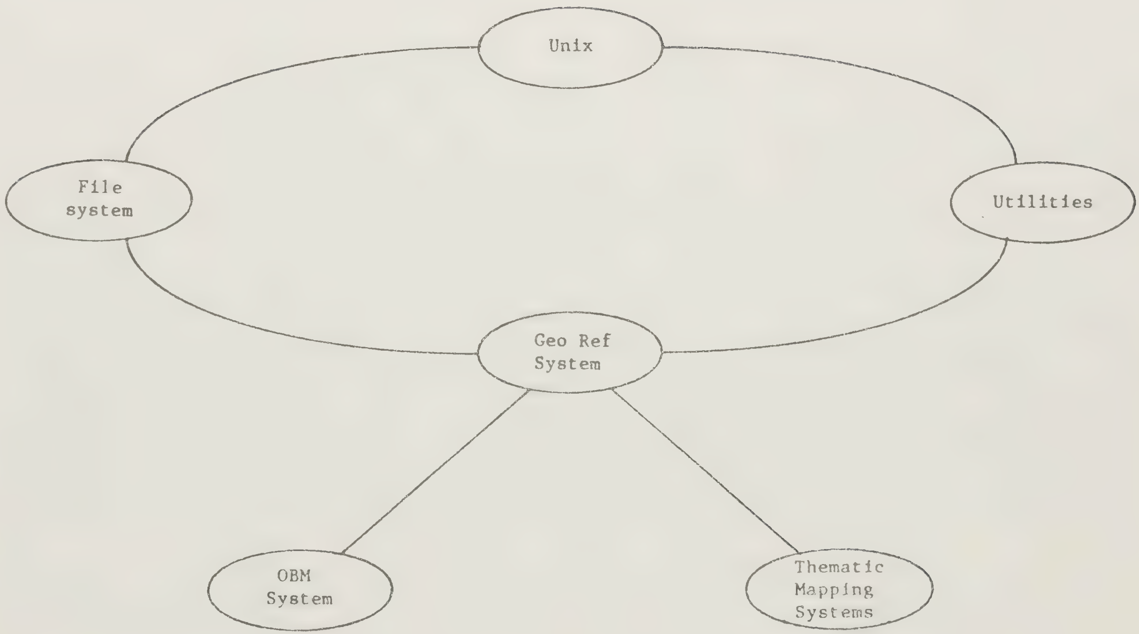
2. A display and drawing capability using both visual display terminals and large high accuracy flatbed plotters.

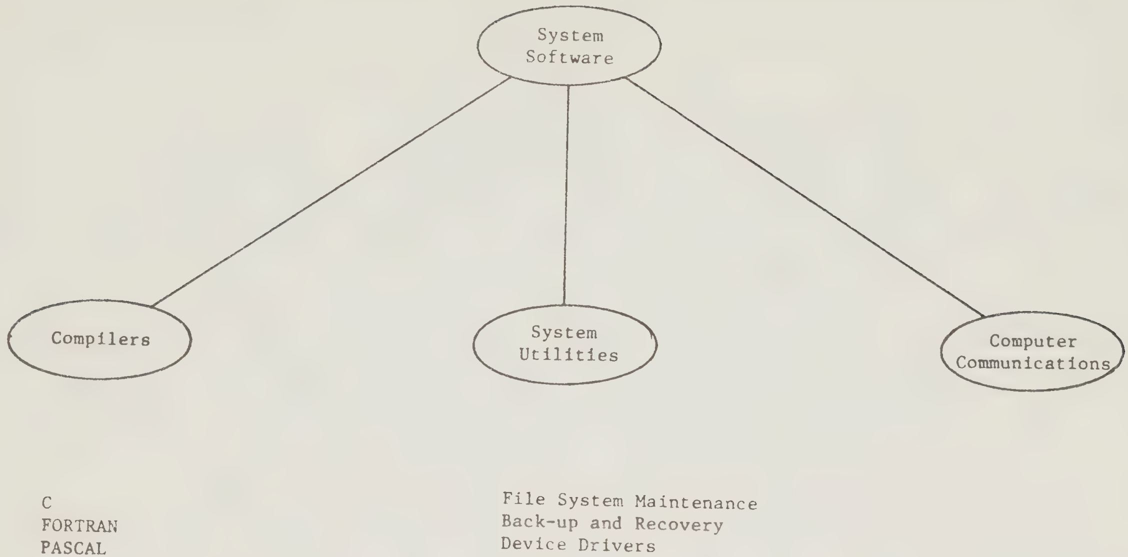
3. Graphics editing for effecting changes due to errors or corrections in the graphics base.

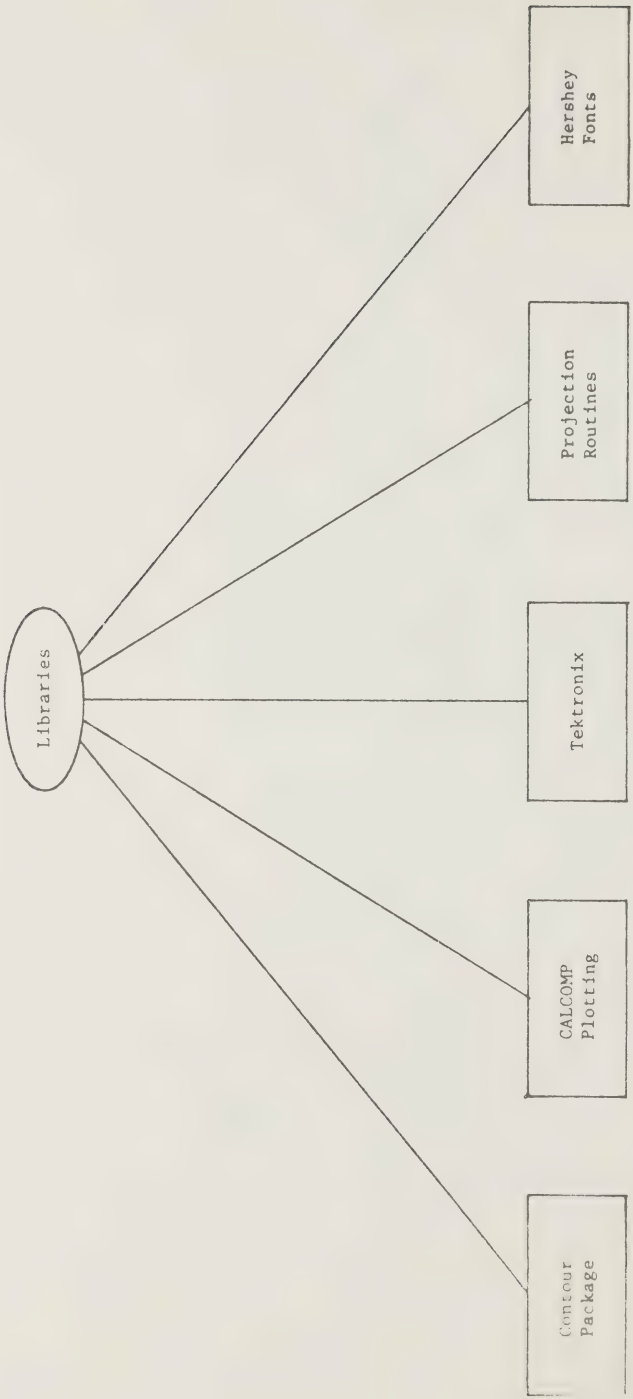
In order to achieve the above, a number of basic system functions had to be implemented. For example, it is necessary to establish a frame of reference within which all of the data can be registered and correlated specifically as the data is derived from a variety of sources. Since it is anticipated that the data will also come from different projection systems, the necessary routines are provided for moving between different projection systems. In collecting the data every attempt has been made to maintain as much of the representation as possible that is not normally derivable or specified without reference to the map sheet. For example the placement of the text associated with the contours was derived directly from a data collection process developed to permit user specification of the associated information.

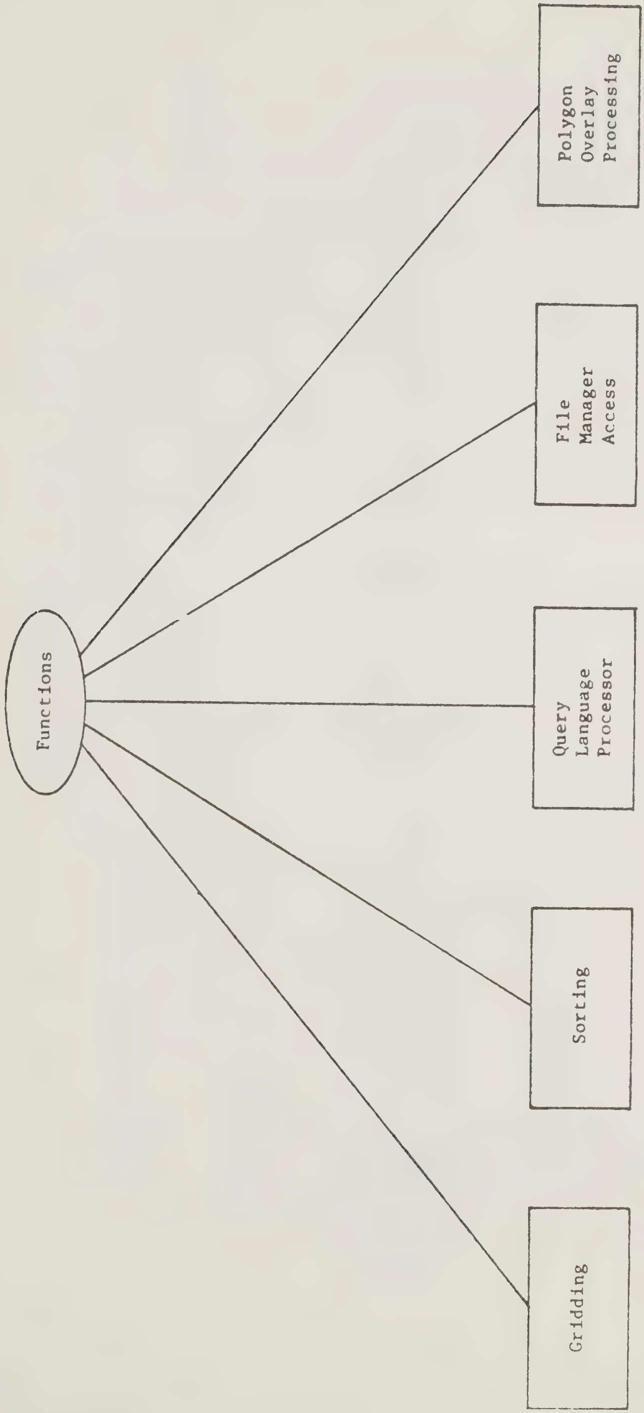

LEGEND
System
Module
Geo Ref System
Data Collection Sub System
(DESC) Design Procedure Generator
Design Procedures (Data Entry Library)
Menu Program
Formatted Screen
Formatted File Input
Data Management
File Manager
Data Dictionary
Report Generator
Data Base Load
B-tree (Index structures)
Archive De-Archive
(Geo Ref Files)
(Unix Files)
Data & System Directories
Geocodes
Edit Sub System
Line Graphics Editor
Polygon Editor
Attribute Editor
Graphics
Graphics Processor
Polygon Display
Symbology
Gridding
Support
Libraries
Functions
Geo Ref Utilities
Systems Software

System Structure

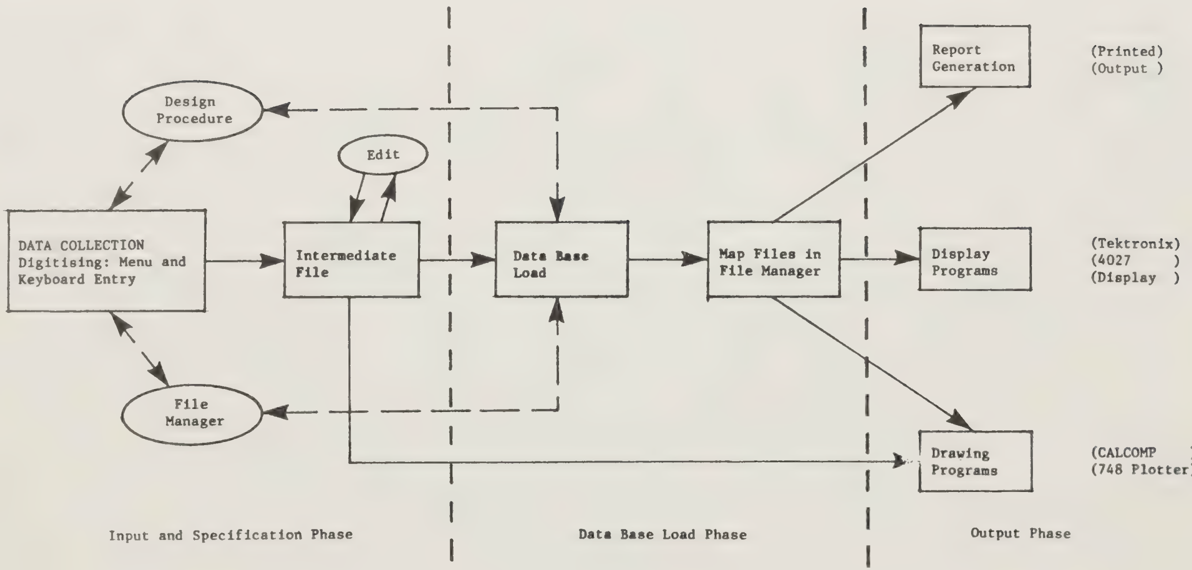



System Software
Compilers
System Utilities
Computer Communications
C
FORTRAN
PASCAL
File System Maintenance
Back-up and Recovery
Device Drivers


Libraries
Hershey Fonts
Projection Routines
Tektronix
CALCOMP Plotting
Contour Package


Functions
Polygon Overlay Processing
File Manager Access
Query Language Processor
Sorting
Gridding

Data Flow in Geo Ref System



A basic requirement identified by the Ministry of Natural Resources is the ability to join adjacent map sheets into larger spatial entities for the automatic extraction of smaller scale maps, such as the NTS 1:50 000 series. The realization of this capability can only be achieved through the deployment of a number of other common facilities. The referencing of the features on a map sheet edge in real time is expedited by partitioning the map sheet into a number of basic grid cells. These grid cells are used only to facilitate accessing the features on the map sheet in real time. Consequently to join the map sheet, adjacent grid cells are examined in turn, and those features which are in close proximity can be checked for matching in both spatial continuity as well as attribute values before being joined automatically. Other features which require enhancement must be examined on the visual display screen and modified by means of the graphics editor.

The development of the basic OBM mapping system has been an evolutionary process and is still not complete in its entirety. The experience gained to date has been extremely useful and is sufficient to provide a basic digital mapping capability for OBM maps. Experience to date indicates that a typical OBM map sheet, if there is such a thing, requires approximately three days of data collection and drawing for its completion. The OBM sheets which have been worked with to date are not rich in culture and it is in this latter area that considerable work remains to be done. The digitization of culture as a graphic entity is in itself a simple task, however, the organization of the cultural features in terms of information structures for use within a data base environment has not been demonstrated. Experience with the use of such information structures in other organized spatial entities such as polygons indicates that we are capable of doing it, however, considerable effort must be expended in order to provide the level of support required in the context of a data base environment.

It was abundantly clear after digitizing some OBM map sheets that for the system to be effective it was imperative that emphasis had to be placed on the data collection process. During this phase every attempt must be made to ensure the consistency and accuracy of the accumulated

information. This is exemplified by insuring for example, that those features which are naturally contiguous with each other are defined to be so by the user and can be validated in real time by the system. This is particularly more pronounced in the case of thematics which must register and tie into the basic map data. In the case of symbology, the symbology cannot be placed automatically. For example, the annotation of contour values is not the type of process which is readily amenable to automation. It is more meaningful to digitize the contours and have the digitizer operator indicate exactly where the annotation value should appear.

Within the current system the emphasis has been placed on building the consistency checks into the design procedures. By so doing it was found that little or no editing was required simply because there were no errors to correct when the effort had been taken to eliminate potential difficulties in data consistency at data collection time.

The basis of the OBM map is to provide the framework for associating other related information within a single consistent system. Essentially this implies that the OBM map constitutes the base and the thematics provide a level of information enhancement with the base. Each thematic must register with the base, however, the thematics do not directly register with each other. For example, soil maps would not necessarily register with forest stand boundary information.

Even though there is now a basic capability for digitizing OBM maps more effort will be required to enhance this process. The refinement of the system technology can only come about through extensive user involvement and experience with using a digital base.

FOREST RESOURCE INVENTORY MAPPING

The forest resource inventory is the major thematic application to be developed within the georeferencing system. The FRI application was extended through a separate contract to develop a management information system specifically for the forestry application based on the georeferencing system as a base.

The primary requirement for forest resource mapping has been to superimpose onto a set of base maps the thematic information which constitutes the forestry information base. Development of the FRI application is exemplified by the evolutionary approach required to produce a final working production system.

The initial attempt to generate the forest resource inventory information in terms of forest stand polygons was based on the digitization of the forest stand boundaries as distinct segments. These segments when combined with the segments found within the base map were synthesized into the appropriate set of polygons. Whereas the polygon synthesis algorithms were found to be acceptable for handling essentially all of the possible instances of polygons, the inevitable inclusion of errors in the source data resulted in even greater errors in the polygon information. For example, the omission of a single forest stand boundary would degenerate two polygons into a single polygon. The effort required to correct such seemingly innocent errors was truly substantial. An even more ambitious aspect of the original approach was to attempt to automatically place the attribute data within the forest stand polygon by use of a variety of algorithms. The difficulty of recognizing the spatial entities in the algorithm made this a particularly difficult task and the subsequent editing required substantial human intervention to produce a realistic and meaningful entity. Consequently it was again necessary to develop new and better digitizing procedures whereby at data capture time all the necessary information could be captured and maintained within the data collection process itself.

The essence of the data collection procedures now is to collect the information from forest resource compilation manuscripts. The basic unit of data collection is a polygon with the individual component segments being defined as either existing (namely old) or new feature information and hence being defined for the first time to the system. In this latter case the full definition of the segment is required, including digitizing its positional element. While the individual segments are being digitized in sequence or defined in terms of existing base features the system automatically checks for their continuity

and consistency. While the polygon feature is collected all of the attributes associated with the polygon which are necessary at data collection time are also collected. To simplify the representation of the forest stand and drawing of the forest stand map the user also identifies one or more trapezoids where the text information can be placed. The simple act of digitizing takes very minimal effort, however it reduces the complexity of the total process considerably.

The FRI application was the first application to make use of higher level structures within the file manager. Essentially a polygon consists of segments of other features which are inter-connected in a meaningful way and maintained as distinct entities within the data base. Note that since there is no double digitizing and no data redundancy in the data base, whenever a segment has multiple use it is necessary that the file manager maintain only a single definition of the feature with all subsequent uses of the element being through references.

LAKE BOTTOM CONTOURS

The creation of lake bottom contour maps for the Wildlife and Fisheries is perhaps the most peripheral of the projects to the georeferencing activity. The project definition required the digitization of the lake shorelines as well as the encoding of the transect tapes for the lake itself. From the transect information a number of spot heights were determined which are then passed through a contouring package for the production of lake bottom contours. A number of associated computations are also made including the lake area and volumes between certain lake depths.

In spite of the basic inaccuracies of the data a number of promising products were derived from the total system. These products are not totally free of blemishes in all cases. The contouring programmes are based on an underlying grid and if the grid is too coarse the resulting contours so produced tend to overlap the shoreline. Steps have been taken to overcome this dilemma by checking whenever a contour line approaches a shoreline and terminating it automatically at the shoreline.

Other problems arose when the lake was too large. Most of the work required for the lake bottom contouring is essentially compute bound, and because of the large data space required this task was performed on the larger Amdahl machine. Attempts were made to partition the task into a smaller set of subtasks which could in turn be run on the minicomputer. However, the elapsed time proved to be too large to effectively tolerate this type of solution. For very large lakes it has been necessary to partition a lake into a number of pieces and provide for subsequent joining of the various components of the lake.

The basic requirement for this system was that little or no special expertise be required on the part of the user. For example, when it was deemed desirable to correct any inconsistencies or blemishes, such as contours overlapping the shoreline by means of interactive editing, this was ruled out primarily because of the sophistication that would be required and demanded of the user.

The basic shoreline data was derived from maps provided by Wildlife and Fisheries. They in turn derive the maps from the FRI maps and hence there is the essence of the georeferencing capability. It is expected in time that Wildlife and Fisheries would simply reference the shoreline from the georeferencing data base and augment this with the transect information. The information then becomes part of a single unified base and is available to others with standard access mechanisms.

LAND REGISTRY

MCCR had identified a number of tasks that are relevant to their own georeferencing needs. Specifically the requirements centered around the production of the number of subdivision plans and their use within the context of land registry. This application was deferred until very late in the project primarily because many of the resources required for it had to be first developed on simpler applications. For example, the structuring of hierarchical information in terms of GEOREF data entities was first completed successfully using polygons for FRI. The

number of levels of hierarchical structure required for MCCR is potentially unbounded and each component segment may have several uses within the context of the land registry environment.

In order to accommodate the MCCR application it was again necessary to develop special design procedures which would provide for both the encoding and capture of this highly structured information. To date only the resulting graphics have been drawn out and we are currently working on building the appropriate information structures for data storage and management within the file manager. The primary difficulty associated with the land registry application is that the various products and information bases associated with land registry must ultimately register with each other. This requires the development of special tools for integration into a logically consistent base. Such tools will include geometry packages as well as a number of manipulative resources as may be required for distributing error, reassigning values, etc.

LAND USE PLANNING

A number of primitive land use planning exercises were identified in the original contract, unfortunately very little was done in this area primarily because the basic polygon overlay capability was only completed towards the end of the project. Since the polygon processing capability is being proven extensively with the FRI application it is a simple matter to migrate this capability to land use planning.

The functional requirements for land use planning have been identified to be:

1. The creation and maintenance of inventories, e.g. shoreline classification.
2. The manipulation of spatial entities based on attribute characteristics, i.e. polygon overlaying in terms of land use classification, soil classification, zoning requirements, etc.

The tools required to achieve the above are currently in extensive use within the georeferencing system and consequently are available for utilization within a land use planning environment. Specifically at this time it is necessary to develop a custom interface, namely a data collection procedure for the collection of land use planning information. However, it is expected that most of the data required for land use planning will normally be derived from existing files within the georeferencing system.

The land use planning application is perhaps one of the most visible generalized user aspects for georeferencing.

GEOCODES

A geocode is a compact encoding of all the information associated with any feature. Because of the diversity of spatial entities encountered within georeferencing it is not possible to have a single format which will encompass all feature types within a single unifying geocode.

The geocode which has been developed consists of a structured vector which is in turn made up of various components. The first set of components provide for the descriptive aspects of the feature, for example, feature classification as well as any relevant attributes. The second set of components within the geocode are essentially computed. These components provide for the encoding of such parameters as perimeter, area, etc. The third set of components are those which are derived, for example, the moments about a given X or Y axis. It has been found that only some of these are meaningful.

Essentially the geocode consists of those aspects of the feature which remain invariant under various transformations. It is clearly a challenge to select attributes or components for inclusion within the geocode which will provide for a unique classification of the feature.

Essentially the geocode can be viewed as a vector of parameters each of which has been selected to uniquely classify or identify the feature.

Different components (parameters) which make up the geocode are required for the different types of spatial entities, for example a point feature would have a rather unique and simple geocode, normally a location identifier; while straight line elements could be classified in terms of two location identifiers, etc.

The role of the geocode is clearly to facilitate the identification of a single feature or a group of features which satisfy a unique set of conditions or requirements. Because of the variability in encoding each geocode the retrieval mechanism itself is statistical. Our initial results to date have been based on the use of a Bayesian model for retrieving geocodes from a georeference data base. Within such a Bayesian approach an evidence model is used to enhance the probability of selection based on the information received at any time. As more information is gleaned about the target geocode the certainty of the selected geocode can be improved. For example if few characteristics of the target feature are known a large number of possible or candidate geocodes would be selected. By specification of further information, e.g. area or feature length, it is possible to restrict the number of candidate features to a subset of the original chosen. By a process of incremental enhancement the knowledge base is improved until the item or items are found as per the requirements.

It is anticipated that a geocode would be used for every feature stored within the data base. At this time the geocode modules have been tested independently of the information found within the data base. However, as the data base is built it is expected that a separate geocode record would be stored along with every feature and every segment of a feature. From the limited test data we have experimented with to date a very high retrieval rate has been found between target and selection criteria. This high degree of correlation may be due to the nature of the data we are working with, however, this data was taken off standard OBM map sheets. Further work is necessary to improve this model and make this totally transparent to the user. Essentially it is our expectation that with the advent of the query language the geocode would be the underlying mechanism for much of the retrieval and manipulation of features within the data base.

PROJECT STATUS

The basic system capability has been developed much as expected and consistent with the original design objectives. The approach taken has been to provide a set of system resources in terms of functions and capabilities which can be molded to the specific needs of a wide variety of disparate users. Even though further functions will be added as user sophistication improves a very strong base currently exists and provides most of the activities as anticipated at this time.

The current system is complete in terms of the anticipated functions excluding a generalized data base query capability. It is anticipated that this aspect of the system development will require six months for design as well as a further six months elapsed period for the implementation of the query capability. It is anticipated that the query language will tie together the system resources in terms of a high level user interface. The query language is seen as the vehicle for achieving many of the global objectives for a georeferencing system, namely data and resource sharing. The capability anticipated is one of information utility in which each user has access to the resources required to effect his mandate as well as providing access to local facilities which may be of value to other users within the community.

At this time the basic concept of georeferencing has been proven and established to the level that is possible to collect, organize, manage, and manipulate the resultant data. Now it is necessary to begin in earnest to collect large volumes of data in order to validate the next level of activity, namely the data base operation. There is, however, some need for further experimentation in the use of some of the more esoteric aspects of the data base operation. This includes not only the data base but a query language capability across a number of data mandate areas.

Much of the georeferencing development represents advanced technology and has pioneered concepts which are not found in current systems.

Often it has been necessary to move from a research to a development mode and back to a research mode in order to accommodate new needs as a better understanding of the problem developed. At this time it is clear to say that the technology for georeferencing is well established and provides a mechanism for the user community to achieve the global objectives for georeferencing.

I know that this is a form of information compression, but I have tried to give you as complete an overview as I could in the time available of what is in geographic referencing and where we really are at. If the Chair Person will permit it, I will be glad to answer any questions, that is unless it is time for the coffee break.

MR. JOHN KERR: Actually we have scheduled a question period for later in the day but since the coffee has not yet arrived, perhaps, Jim, you could spend a few minutes to elaborate on the geocode module you are developing.

DR. J. LINDERS: Essentially the geocode is nothing more than an information structure that will allow us to quickly reference the feature or the part of the feature that we are interested in. The simplest type of geocode you can think of is a location identifier. If you want to describe the location of a point, then it is easy because you can say the position of it is its geocode. If you want to describe the position of a parcel, it may not be so easy. You could describe the centre of the parcel as such a point and in some cases the centre will be easy to define, particularly if the parcel is rectangular. Obviously one could draw two diagonals across the parcel and the point of intersection would always be the point geocoded. If it is a lake whose position you are attempting to define, you could select any arbitrary point in the middle of the lake but now the problem gets nasty; the moment you start doing things like this you are taking the problem out of your domain, and you are putting it into my domain. It is now necessary to start searching to find that particular entity. This is not impossible, but it is not a nice clean, simple solution either. It is much better to have a description of the particular entity, like the lake. We can digitize a feature and essentially produce a geocode for it which hopefully approximates the geocode that was put in if we had a data base.

For example, if we take a wildlife and fisheries map, and digitize the lake. We need a positional element for it — this goes without saying. If we do not have a positional element, life really gets nasty. It is not impossible, but it's nasty because we have no positioning element within the data base. We only have shape. What will happen now, is that we take the geocode we produced by digitizing (I will talk about what sort of components are in it later) and then we match this against the geocodes of features we have for that part of the data base and, hopefully, will find the feature by comparing geocodes.

The sort of things we keep in the geocode are described in terms of a list of parameters, i.e. it is a factored vector consisting of groups of entities. One group of entities in this geocode relates to attributes, maybe the feature type, maybe some elements of classification; another group might pertain to computed values, etc. Computed values are things like area and perimeter. If we know these values, we can certainly simplify our search. Another group of entities might be components which relate to derived elements. For example there are some invariants we have discovered. We can take the second and the fifth moment about some arbitrary line like the base of the map sheet. These moments are quite unique, and we store them in the geocode. The more information we have, of course, the easier it is to find, and we use a particular statistical model for doing the matching between geocodes to find out whether they are close enough together to be able to justify or to identify a target geocode.

The geocode is something that should be transparent to the user. In other words, a user should be talking to the system about the feature he is interested in; he should be describing it to the system in terms of its positional aspect and in terms of its attributes, etc. The system should generate the geocode and we should keep all the geocodes within the data base. They should not be visible to the user. The things that should be visible to the user are what is natural to

the user. Features are natural to the user. That is what he sees on a map sheet. If he can identify something on a map sheet, then there is a means of producing a geocode (or an encoding) for it and we have a means of searching to find that thing within the data base.

CHAIRMAN IVES: You mentioned a little bit about cost at the beginning of this. One of the things I found in the original terms of the contract was some report on cost effectiveness or something equivalent to that. Are you prepared to make any comments about that at this point in time?

DR. LINDERS: Sure. First of all, I will give you a rough idea of how long it takes us to digitize the various products and build the information base. It would appear that a typical OBM map sheet takes us about three days; some might take less but some certainly will take longer. I would say at this point an FRI sheet takes probably a bit longer than that — I would say four days, and maybe even five days. As time goes on I would expect this to improve, but I will be very surprised if we will do an FRI sheet in less than three days. If Dave Poetker is here, he could probably answer it better than I could. Dave, how long is it for an FRI SHEET? (Answers off mike, about three days.)

Now it gets back to this question of complexity. There is no such thing as a standard OBM map or a standard FRI map. I would say, if we are looking at an FRI sheet, we are looking at a week for everything and I think that would give you lots of room. To look at an OBM sheet, because they tend not to be as detailed, I would say you are looking at probably three days. I think we will need to run through 200 or 300 sheets to get realistic numbers; I believe at that point we will find out that it is a cost effective solution — but then I am a highly biased individual. I maintain it can be cost effective. We are still in a development phase, and there is a learning cycle that the Ministry has to go through now. We have done a lot of development and we have a lot of experience, but that

has not been transferred to the Ministry, which must happen now. I believe we will find that it will become a cost effective entity, and then, when we look at all the by-products that come from it, i.e. the secondary benefits, then I think it really will pay off. But I have no honest-to-goodness answers that would make you happy.

Q: MR. GREN ROGERS (INCO) Sudbury: You made reference in your talk to automated cartography and having been able to use the experience you gained with Energy, Mines and Resources Canada. I was wondering if there is any indication of how much time and money has been spent on automated cartography by that Department and how many maps it has produced?

A: DR. JIM LINDERS: Let me qualify what I said. I was pointing to the original XCM development where we moved from an initial graphic system that was essentially an emulation of manual method, to an information base which was what XCM represented. I think since then they have gone to M & S as the front end phase but I believe they are using the XCM system as the output phase. Perhaps Stephen Law, who is here, or Mike Young, could provide better information on this.

MR. MIKE YOUNG (Topo Survey, EMR Canada): You have answered the question insofar as the development of automated cartography and the XCM system are concerned.

The initial development of an automated cartography system in which input was manual digitizing of graphics evolved into a cartographic data base system with the development of XCM. Subsequent integration of a photogrammetric digitizing and cartographic edit system using interactive graphics technology has led to the present digital mapping system which has been in production on 1:50 000 mapping for two years. This development has taken place over the past decade and has been aimed as much at remaining at the forefront of the technology as putting the system into production. To date, approximately fifty maps have been digitized and eight or ten have been published. Much of the expenditure involved has been amortized as development costs and determination of a realistic cost comparison is difficult. However,

considering the capital investment and maintenance costs involved, production of medium scale topographic maps by digital methods is more expensive. How much more, I cannot say, but I believe this is more than offset by the value of the digital data, not only for general use, but for the savings to be gained in revision.

DR. JIM LINDERS: Thank you, Mike. I guess we can leave it at that. Thank you (Applause)

CHAIRMAN IVES: Thanks, both Jim and John for reporting to us on something that I know you both have worked very, very hard on in the most recent past, and I would like to congratulate you both on your presentations and the progress that you have managed to achieve. It is somewhat refreshing to hear Jim Linders say, or admit, that it has been hard to understand an application area. I feel like I have had those shoes on so often when it comes to his own application area. I did not know whether to feel insulted when he kept talking about the "simple" emphasis he had to put on everything, because today, for once, I felt I was beginning to understand and I do not know whether that makes me a simpleton or what. I am reminded of one ICOGR member who once admitted to me in a corner of a room one day, that he was scared because he found that he was beginning to understand and be able to communicate with Jim Linders, and he did not know what that meant. (Laughter) So with that, I think the coffee will be here and I hope we can keep it again to fifteen minutes, because we still have another presentation this afternoon and then hopefully some time for questions. So please start moving back at a quarter to three. Thank you very much.

— COFFEE BREAK —

CHAIRMAN IVES: Our last speaker this afternoon, or our last paper anyway, is by no means the least paper, I can assure you, because it is my pleasure to introduce a fellow forester. I can tell you I had no idea that there would be so many foresters here today or that I would have the opportunity to introduce or be introduced by so many of them. (Laughter) John Osborn is somebody I can really sympathize

with since he has had to learn to apply the world of computers as a tool to achieve an end; in his case it is forest management. I am sure that the rest of you are as anxious as I am to see how someone has actually managed with actual hands-on experience, and how they have fared with the georeference system that we just heard so much about in the last hour or so. John. (Applause)

FORMAGAIN

(Forest Management Agreement Area Information System)

DR. JOHN OSBORN
TIMBER SALES, MINISTRY OF NATURAL RESOURCES

Thank you, Laura, very much. It's obviously apparent from this morning's series of introductions, and just now, that foresters have a sort of special appeal in this part of the world. Today we can afford a few rebels, and what I intend to talk about for an hour and a quarter this afternoon is rather a rebellious system.

This paper will present a brief overview of FORMAGAIN. It will include its components, its history, its procedures, its status, and its future with particular reference to its use of computerized forest management information.

In forest management we are directly concerned with action — e.g. building roads, cutting trees, preparing the sites for regeneration, planting or seeding, and protecting the desired trees from insects, fungi, climatic catastrophes and "weeds". To derive the best results the forest manager poses, and must answer certain basic questions. These include the policy questions of "What should I do and why?", plus the tactical questions of what do I actually do, where, when, how and with whom? Given that the range of alternative answers for forest management is large the forester must decide which alternative to follow. Obviously this necessitates a planning, action, and reporting process. Furthermore, the actual choice of plan to implement follows an analysis of alternatives. In these analyses the question "where?" is one of the most important. The areal coverage of a forest estate is large. Most forest actions call for on-ground access and roads are expensive. Hence the economic implications of the "where?" questions are very important. This computerized technology being discussed today is an aid to the analysis and answering of the "where?" question. However, I repeat again this technology, this information system, is an aid to forest management. It is a means to an end and not an end in itself.

Forest Management Agreements

In 1977, the then Minister of Natural Resources decided that the forest industry should have a greater involvement and responsibility in forest management. Details of what this meant were to be described in contractual Agreements between specific forest industries and the Crown. This idea decided upon by the Minister has been implemented. Forest Management Agreements (FMAs) describe who will do what, how, when, where and why on a specific legally defined part of Ontario - viz. a Forest Management Agreement Area.

Since the 1940s foresters have managed the forest-based resources of the Province in clearly defined management units. As an aid to these management actions they developed and implemented a Province-wide management planning system in the 1950s. This included an inventory of the resource (resulting in maps and numerical tabulations), analyses, management decisions written out as twenty-year, ten-year, and annual plans, and a reporting system of actual achievements. This management planning system has been followed by forest industry in its operations on Crown land.

When Forest Management Agreements were developed in 1977 it was decided that this well-established management planning process would be used. The process was to be enhanced and made more "accessible" to users.

The management planning process is based upon the forest resource inventory (F.R.I.). This inventory provides a Province-wide description of the resource for long-term planning. The data are now in a comparable format across the entire forested part of the Province. Inventory data are built up in a specific hierarchy and a description of this hierarchy is given in Table I so that you can understand better why certain problems and events have developed with FORMAGAIN.

TABLE I

Hierarchy of the Forest Resources Inventory for Forest Management

Major Level (smallest to largest)	Type/Name	
1	Polygon, e.g. Forest stand, or Non-productive, or Non-forested piece of land, or water body.	Polygon area 5 acres and larger. Forest stands uniquely numbered. Other polygons numerically classified.
2	Mapsheet, e.g. Township or F.R.I. basemap (15'x7½')	Forest stands numbering series by mapsheet. Maps @ 1:15 840 in all Ontario except 1:10 000 in extreme south.
3	Working Circle	One or more mapsheets. Typically 500-1,000 square miles (10-40 mapsheets).
4	Management Unit	One or more Working Circles. Typically 1,000-5,000 square miles.
5	Province	

Forest Management Agreements to date have been existing Working Circles or Management Units. A map of the Province, its subdivision into Management Units, and showing existing and likely 1981 FMAs is given in Figure 1. With reference to both Table I and Figure 1 the subdivisions of the Province do not coincide with the more changeable (less stable) administrative subdivisions of Natural Resources' Regions and Districts. The other item to note is that forest stands are uniquely referenced in the Province through their stand number and mapsheet.

It is these inventory data which form the underlying basic data of FORMAGAIN. It is this databank arrangement or hierarchical structure that forest managers wish to use.

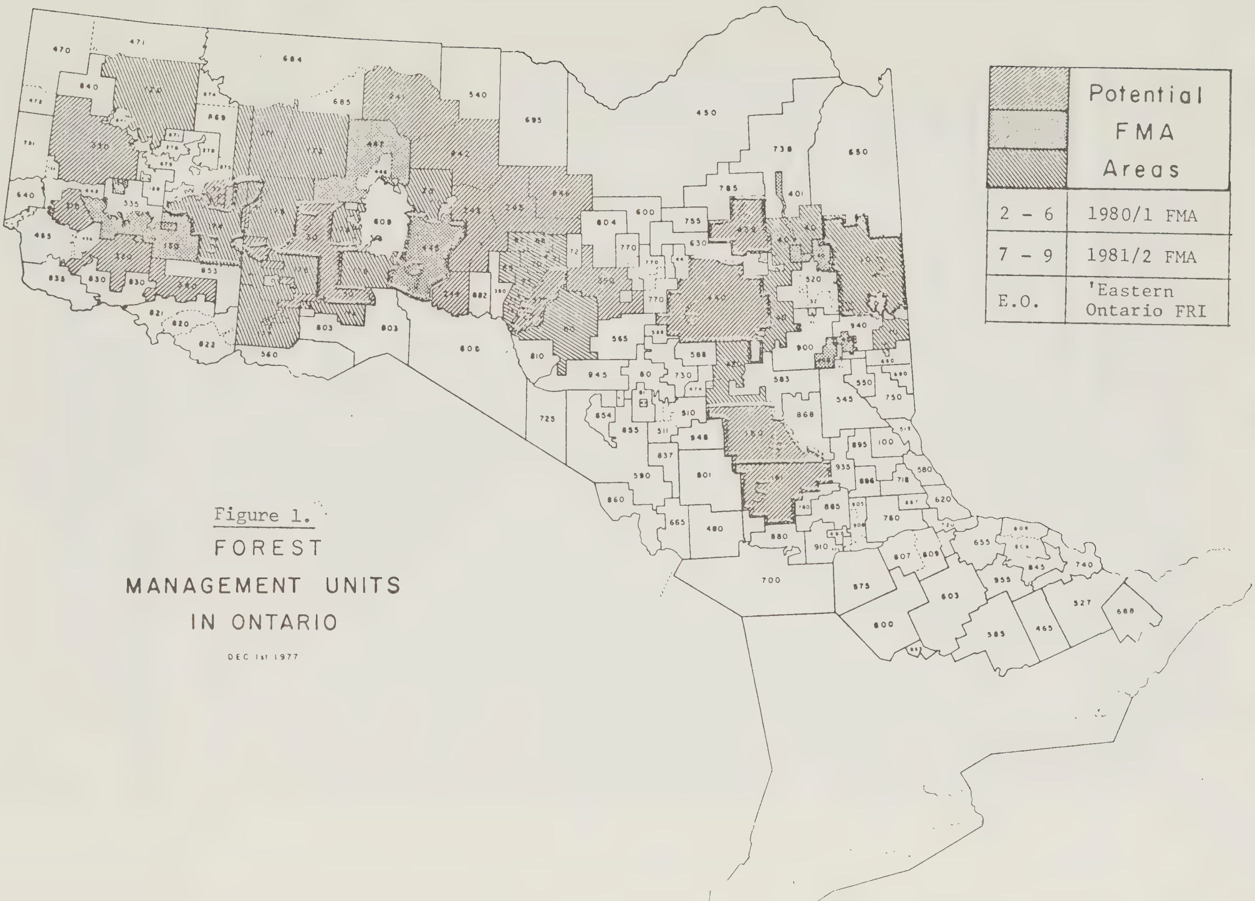


Figure 1.
FOREST MANAGEMENT UNITS IN ONTARIO
DEC 1st 1977

When the processes of Forest Management Agreements were discussed with forest industry the Crown promised to design, develop and make available an information system. This was to be a system whereby both the Crown and Agreement holder knew the status of management (inventory, demands, plans, actions, results) on a particular Agreement area. At the end of 1977 the author was given the responsibility of implementing this promise of MNR. This resulted in FORMAGAIN which is a clumsy acronym for: FORest Management AGreement Area INformation.

FORMAGAIN - System Search

In 1978 the components of FORMAGAIN were defined and the type of system required was configured. Several Ministry foresters started searching through existing systems. This included investigating both users, especially other forestry organizations in Canada and the U.S., and vendors. Systems covered included those of Calcomp, Calmagraphic, Canadian Geographic Information System, Canadian Soils Information System, Comarc, Computervision, M & S, and Timberpak of Earth Resource Satellite Inc., plus IBM's developments in this field. A synthesis of the foresters' requirements and an analysis of different ways of attaining these was documented in a Feasibility Study in 1978/79. Given the lack of computer expertise in MNR, the need for an operational system by 1980, and the then-available systems, this Feasibility Study recommended the tendering for a commercial turnkey system. The estimated capital investment was approximately $620,000. Had this recommendation been implemented a computerized system for many of FORMAGAIN's requirements could have been operational by the end of 1980. The recommendation was not approved and Forest Resources were told to incorporate their requirements as a thematic application of MNRs Lands and Waters Georeferencing Project.

Georeferencing - FORMAGAIN Integration

In early 1979 a contract was signed between the Crown and the University of Guelph to assess whether the digitization of Ontario Basic Maps and the production of maps and the attendant digital data was a cost-effective approach. This was to yield a fully documented pilot

production system by March 1980. In addition, the contract was to produce a system which would let certain thematic applications operate in a data compatible fashion. Amongst these thematic applications was that of forest resource inventory and two of MNRs foresters were on the GEOREF Steering Committee.

This project has already been described by J. Kerr, but from FORMAGAIN's point of view, March 1980 arrived with no system and a tenuous ability to produce forest inventory data on OBM maps. This production of F.R.I. maps had been achieved by the foresters first transferring their 1:15 840 map data by hand onto 1:20 000 OBM map sheets. Problems of map scale, map projections and map sheet format (edges) were resolved by hand, not by computer. Considerable effort was expended by the University of Guelph team in research and development, but the end product was far from the desired FORMAGAIN system. Remember, however, the University of Guelph GEOREF contract did not propose to deal with the requirements of FORMAGAIN. Moreover, it should be clearly understood that FORMAGAIN needed a system which used the existing Forest Resource Inventory data, i.e. maps of Townships or F.R.I. basemaps at 1:15 840 on a conic map projection with two standard parallels and attributes (Forest Stand Descriptions) on computer tape. Furthermore, we wanted the system (the use of the computer) brought from the computer scientist's level to a very-easy-to-use level for forest managers. Also, with reference to Figure 1 it is obvious that the locations of the Forest Management Agreements are not where the OBM map coverage is. Finally, OBM coverage is not planned to be in FMA locations for up to ten years. Nevertheless FORMAGAIN is needed today.

FORMAGAIN - Guelph Contract

At the end of 1979 the Feasibility Study recommendation had been turned down and the Forest Resources Group were told to build on GEOREF. By April 1980 GEOREF hadn't progressed far enough. Nobody else in the marketplace knew anything about GEOREF and so the Crown signed a contract with the University of Guelph to run until March 31, 1981 which is to produce a production system which will be:

(i) compatible with GEOREF;

(ii) completely documented;

(iii) usable by non-computer scientists;

(iv) able to input existing FRI data;

(v) able to be edited and loaded into a database;

(vi) able to plot out maps of user-specified format, scale, area coverage;

(vii) able to output FRI numerical tabulations;

(viii) able to update the database for changes to the forest inventory caused by cutting, blowdown, burning, regeneration, road building; and

(ix) structured to permit inquiries regarding status including queries of user-specified parts of the database and queries using overlays of different themes.

To keep the above in a clear perspective this contract had three major parts. These are listed below and then described in more detail. As an aid to those of you unfamiliar with the Ministry's Forest Resource Inventory map appearance there is an example given as Figures 2 and 3. In summary the contracted system was to:

1. Take existing FRI data into the computer and be able to reproduce it - a graphic system capability.

2. Be able to update by automated polygon overlay processing and interactive editing where necessary.

3. Be amenable to database inquiries.

FORMAGAIN - The Components

Reference to Figure 4 shows the major components of this system. Some of the components are very complex processes and some are inputs or outputs. Proceeding around the boxes of Figure 4 we have:

1. FRI maps and tapes. This is the original, or initial input. Maps of the Forest Resource Inventory (or OBM maps if and when available) are the basic graphic input. The computer tapes are the input medium for the FRI attributes.

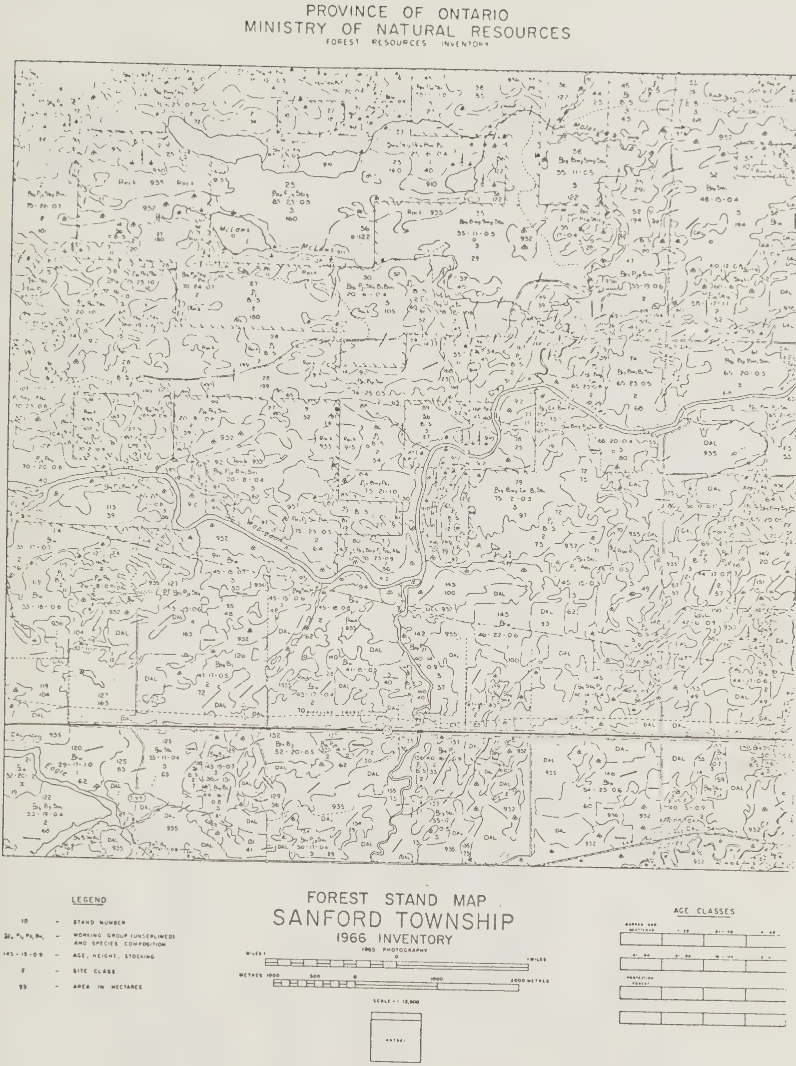
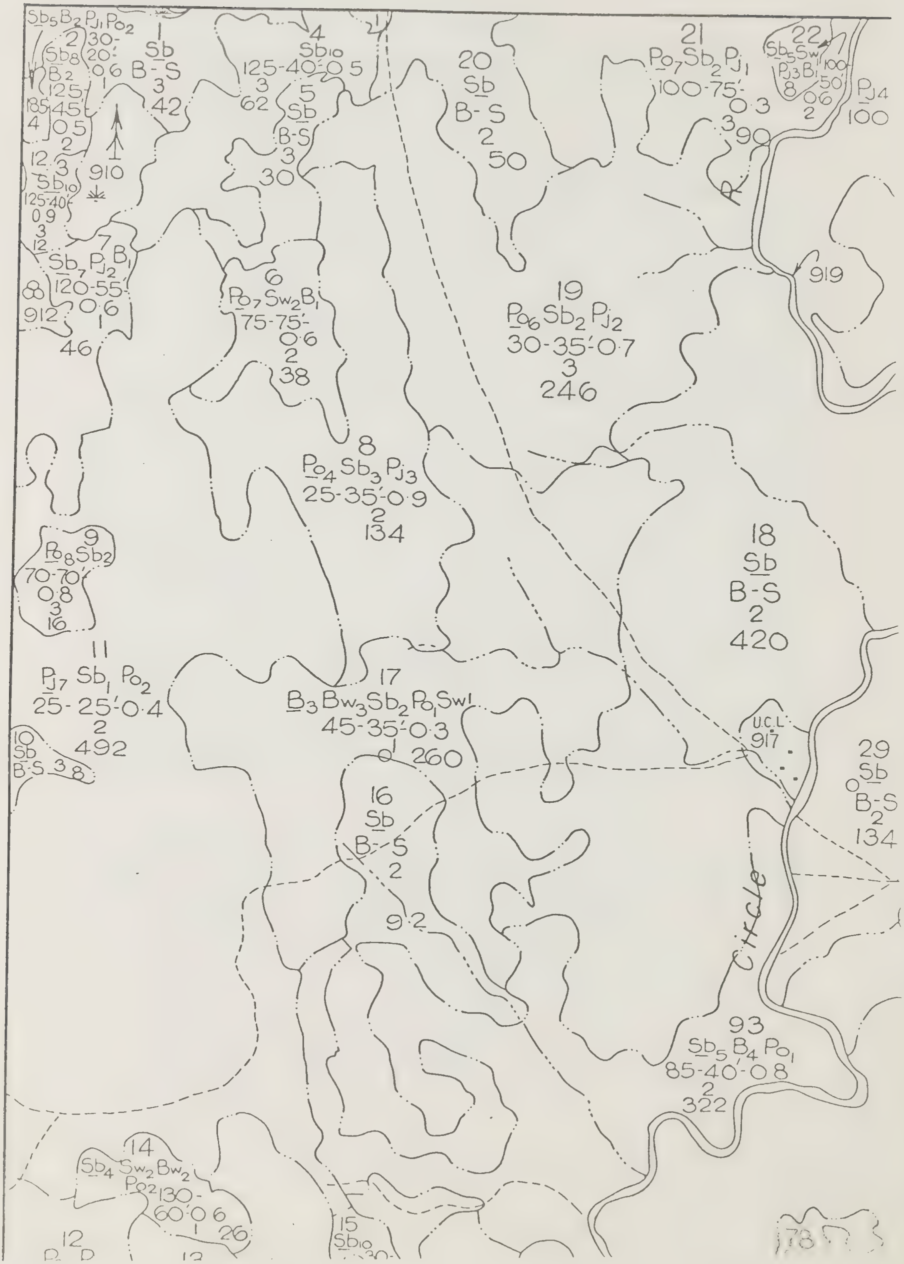


Figure 2. An entire Forest Stand Map as a Township sheet.

Figure 3. Part of a Forest Stand

Map at 1:15840



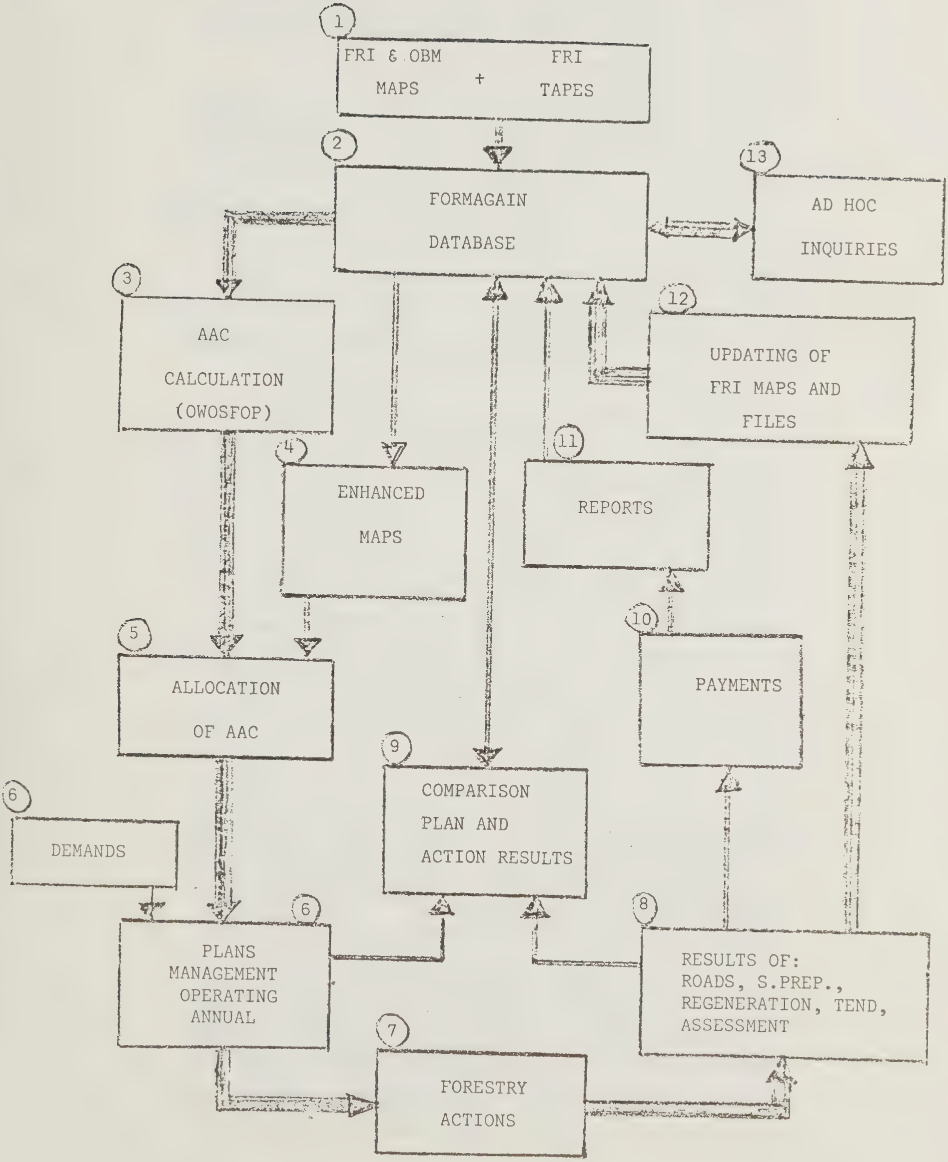


Figure 4. FORMAGAIN THE SYSTEM COMPONENTS

2. FORMAGAIN database. The FRI maps are digitized, edited, rotated, scaled, merged with the FRI attributes and loaded into the database. Software for these operations is one of the three major components of the FORMAGAIN-Guelph contract.

3. Annual Allowable Cut (AAC) calculations. Based on the existing inventory at the beginning of a planning phase a calculation is made of how much of the resource can be harvested to attain the management objectives. There are three planning phases in Forest Management Agreements. There is a Twenty-year Management Plan, a Five-year Operating Plan and an Annual Plan. Allowable cuts are recalculated every five years. A computer simulation model with the acronym of OWOSFOP is used.

   Ultimately in FORMAGAIN this computer model will call the FRI data from the database, perform the calculation, and file the results. In this paper we will not say anything further about OWOSFOP.

4. Enhanced maps. Whereas the allowable cut calculation determines "How much?" it is also important to determine "From where?". The process which answers that question is called allocation - see Box 5. An aid to that process is the highlighting (colouring) on maps of those stands eligible for allocation. Foresters try and cut the oldest, most decadent and slowest growing stands within logical constraints of silviculture, access and economics and regenerate these cutovers with a more vigorous stand. Software in FORMAGAIN lets a user specify which stands are to be highlighted. The result is enhanced maps showing the manager possible allocations.

5. Allocation of the AAC. This is one of the most influential decisions of the forest manager. At present it is done by a manual synthesis of maps, biology, economics, available equipment, forest sites, and seasonal variations in conditions, to name a few. In FORMAGAIN it is proposed that

there be a computer graphic aid for forest managers. A digitized map(s) is a start on this aid. No further work has been done to date on this subprocess and as such it will not be discussed further.

6. Demands and Plans. Users demands (mill requirements), forest resource supplies (allowable cut and its allocation) and other management objectives or constraints are all melded together in a set of written documents - plans. Presently this is all done manually following the instructions in the Management Planning Manual. Given the interaction of most of these processes, the fact that some of the key results are numerical tabulations and/or maps, the intention in FORMAGAIN is to have these processes and results (plans) as part of the "database". Thus the allowable cut calculation result agreed upon, its final allocation, the tabulation of demands, and the tabulation of proposed actions of cutting, regenerating and tending would all be entered, stored and accessible on a database. As with allocation this is still on the drawing board. Enough said!

7. Actions. This is not really a part of FORMAGAIN but it is FORMAGAIN's *raison d'etre*. In fact, from a forest manager's point of view the vital ingredient in Forest Management Agreements is this ACTION process. FORMAGAIN is merely a possible aid to this end. The end is action - a viable forest and forest industry.

8. Results of road building, site preparation, regeneration, tending, and assessments. FORMAGAIN currently has a very narrow look at forest management. It is primarily concerned with those actions which the Crown is funding, apart from depletions. Processes here record: areas depleted (cut, burnt, blowdown, defoliated) and their new status (description); road built (amount, location); areas site prepared, regenerated and tended with details of amounts, where, and how. Finally there is a series of field assessments which are recorded. All these data are

kept as maps, numerical tabulations, and verbal descriptions. FORMAGAIN will use an existing set of processes of MNR and modify these to feed into the database as described in Step 12.

9. Comparison Plan and Action. As inferred in Box 6, it is intended to load the plan into the database. Similarly the results of the actions would also be loaded and the numerical tabulations would be easily compared. It is planned that this process be done by user inquiry into the database as Figure 4 suggests. Every five years a thorough analysis must be made. This is to determine whether the forest productivity is being maintained. This analysis is a further refinement of this step.

10. Payments. In Forest Management Agreements the Crown pays some of the costs of road building, site preparation, regeneration and tending. Data from the recording of the results are used to substantiate invoices.

11. Annual Report. Legislatively the Minister has to report annually the achievements on each Forest Management Agreement area. This report is a tabulation of acres cut and treated and miles of road built. Although the legislation does not call for a map at present, the system must provide such results.

12. Updating of maps and files. As described in Step 7 Actions happen. These actions change the resource (the database) and a new description is given in Step 8. As a result these new representations replace the old descriptions. This updating needs to change either the attributes only or the map configuration and the attributes. In FORMAGAIN the software for this process is exceptionally important. The Crown has a manual system for updating maps but it is time-consuming and inefficient. Updating of attributes is computerized today. In FORMAGAIN we intend to update the database annually for both attribute and map changes.

13. Ad hoc inquiries. Neither the name nor the location in Figure 4 does credit to the importance of this process. The software developments in this "query capability" may prove to be the real benefit of FORMAGAIN. Much of Steps 1 - 12 have been concerned with an enhanced graphics and reporting capability. However, given that all the data are in a machine-readable form for the graphics updating, then if the database of Step 2 is appropriately constructed the forest manager's ad hoc inquiries can be accommodated. As mentioned in the Introduction, the forest manager will be able to formulate his alternatives and perhaps through a simulation model assess the potential results of the alternative. With the "maps" in the system he will be able to see the possible locational impacts of his strategy. To date there is not enough time to do this manually. The Guelph FORMAGAIN contract was to produce a production system version of the Steps labelled 1, 2, 4, 12 and 13 of Figure 4.

The FORMAGAIN System - Capturing of the Data

The Forest Resources Inventory system makes use of two types of map. Both are used in the capturing process. We have a planimetric basemap of 15 minutes by 7½ minutes in size, and a forest stand map. The latter may be of basemap format or on a Township format. If the forest stand map is that covering a Township the size will vary but typically includes 9 mile square, 6 mile square and irregular shaped Townships. Examples of planimetric basemaps and Township forest stand maps are given in Figures 5 and 6 respectively.

Data of the FRI is presently in two forms. Part of it is on hardcopy maps. Some of the map data and other additional data are on computer tapes. In FORMAGAIN where these data exist in these two forms we digitize the maps but do not key in all the attribute data. These attribute data (on tape) are read in from tape and merged later in the process.

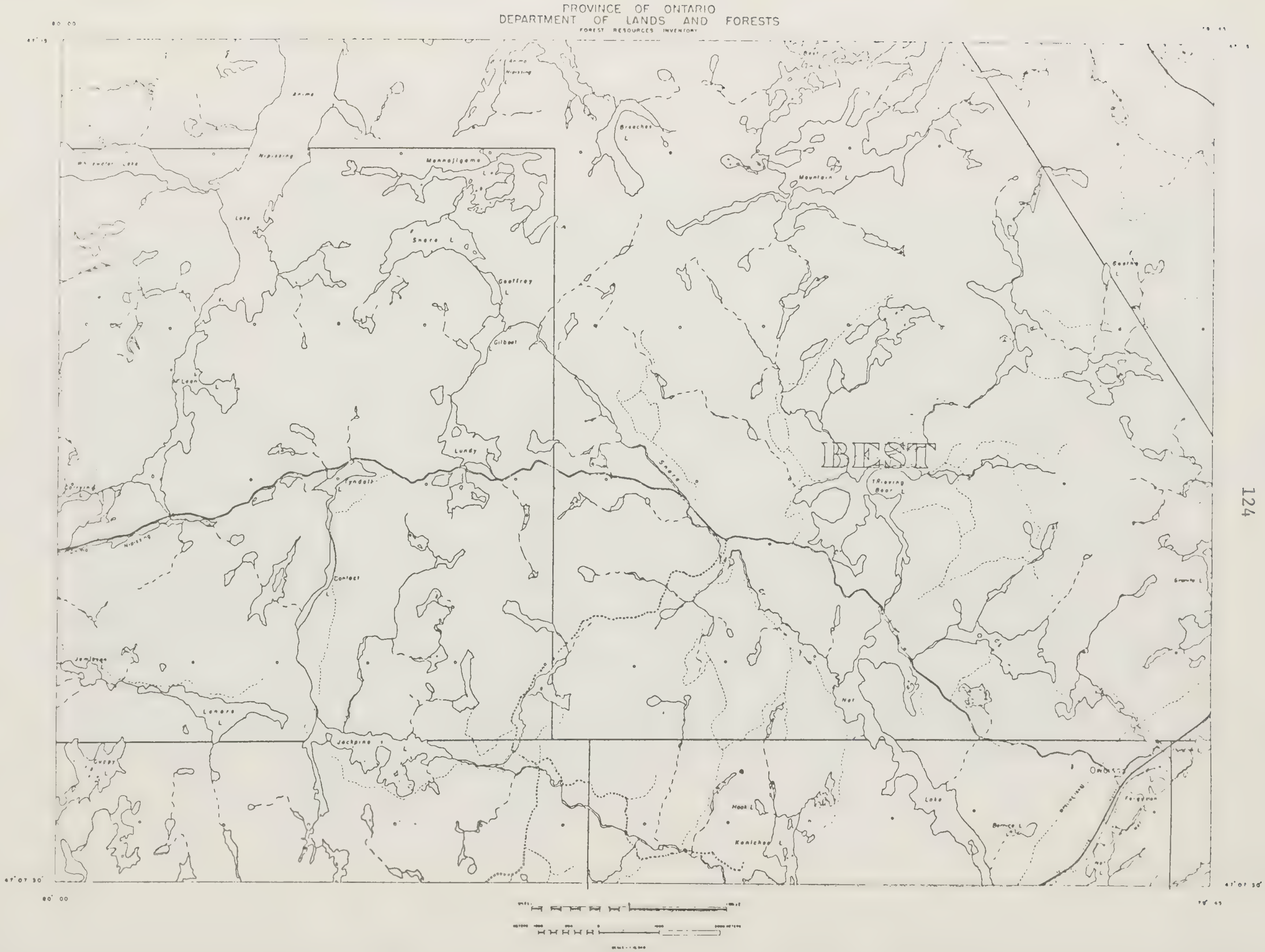


Figure 5. Forest Resource Inventory Basemap with planimetry only.

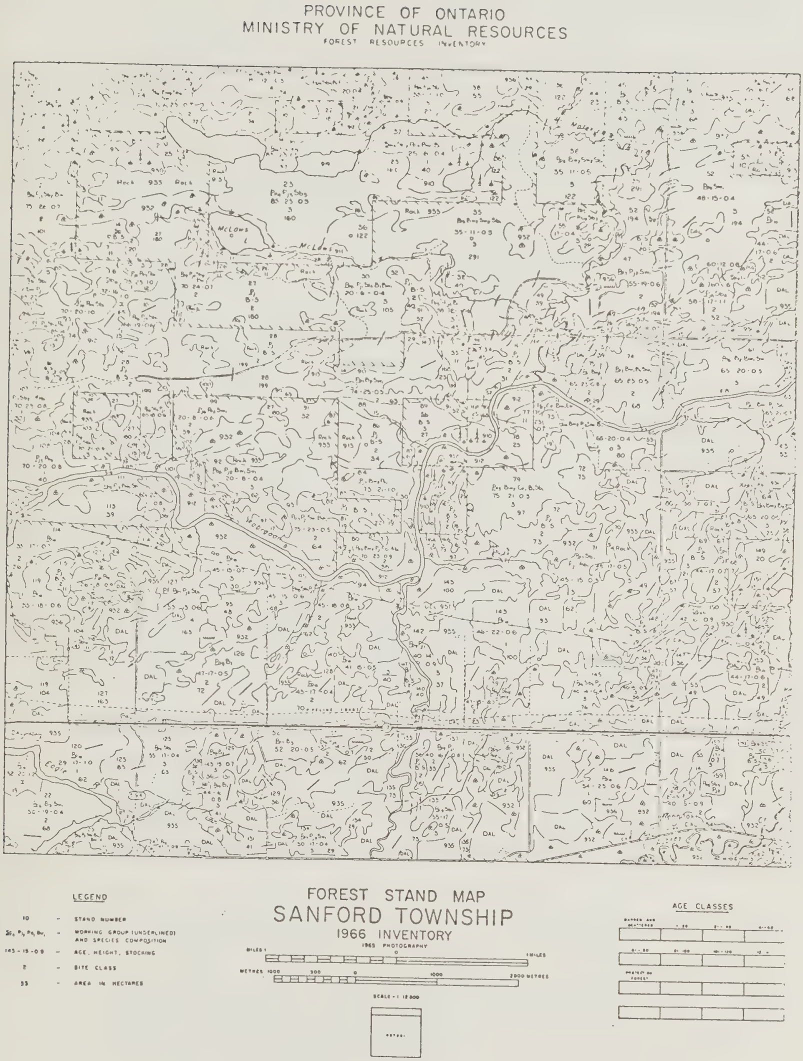


Figure 6. A Forest Resource Inventory
Forest Stand Map

Map digitization is done using a GTCO digitization table, a free floating cursor, a user-generated menu, a keyboard and an alphanumeric terminal. There is no graphic terminal used in digitization.

In concept the planimetric basemap frame is digitized first with its known Latitude and Longitude frame of reference, known scale (1:15 840) and known map projection (conic with two standard parallels). This is the basic georeferencing frame in capturing the data, but not necessarily the basic file for the database. Also on this basemap the borders of the Townships, if any, are digitized.

Then the forest stand map is digitized. If this forest stand map is a basemap in format the two digitization steps are combined into one. If the forest stand map is a Township the previous dimensions from the basemap are used to define the geographical reference frame of the Township. Forest stand map data from a Township map are adjusted to fit into the Township geographical frame.

In the digitization of a forest stand map the operator first identifies the mapsheet, scale and the map neatlines. Next the drainage, culture (roads/railways) and cadastre feature classes are defined using the menu, the keyboard and the cursor. The data capture design procedure software leads the operator through the sequence by posing questions on the alphanumeric terminal. When capturing the forest stands (polygons) each segment is captured separately. However, the software forces the operator to identify all the segments of the polygon. If the polygon is not complete the operator cannot proceed. Either the last segment or the entire feature must be done again.

Each segment is only digitized once. The features on either side of a segment are recorded at data capture time, i.e. topological data. This is very important for some of the forest management questions. If a segment to be digitized is already in the system for another polygon or linear feature the digitizer operator refers to it as "old" and identifies only the beginning, any other point on the segment and the end point. The system then checks that the segment genuinely is in the files.

Thus, at data capture time entire polygons are identified complete with their forest stand number. This number is entered from the map by the operator and the system subsequently uses this unique mapsheet identifier to correlate with the correct attributes from the computer tape of attributes. Thus FORMAGAIN software relieves the operator of having to type in attributes. This approach has evolved from other previously-tried less efficient procedures.

We have tried to let the operator do the things he does best and let the machine do the tasks at which it excels. Therefore we have the operator define where the text or symbols should go at data capture time. The operator can see from looking at the map, looking at the existing symbology or text list, where it will best fit in the polygon. For the computer to do this automatically is an expensive and inefficient process. For the operator to do this on a graphics screen, polygon by polygon after data capture, is too time-consuming. We have tried it!

The FORMAGAIN System - Storing the Data

Datacapture results in a series of X, Y table coordinates in a file of a mapsheet. Associated with this file are the reference frame data, the types of segments and features, the reference (pointers) to previously captured segments, the unique numbering of polygons, and the location data for map text. We also have noted, for example, whether the feature is an island within another feature; whether the data are sparse and need be fitted with spline routines.

Basically there follows a series of processes which result in the data being correctly loaded into a file manager. These processes include rotation and scaling, initial plotting and graphic editing, interpreting and attribute merging, and finally actually loading into the file manager.

From the intermediate files created by the data capture design procedure we plot the graphic representation of what was digitized. Still to be developed are a couple of very useful diagnostic reports. The plots, which can show different types of segments as different plotted colours are used as an aid to edit the graphic. The diagnostic reports would list all the stands by number and show their calculated area. A quick scan of this list and the existing reports of the FRI would show us which stands were missed completely and give an indication where digitization was suspect, i.e. gross differences between FRI and digitization areas. The plots optically aid this identification of graphic errors.

At this stage the graphics editor can change (shorten, lengthen, remove, add) segments. It cannot change nodes - that requires a polygon editor which comes later. Editing is done at a Tektronix 4027 colour graphic terminal. One or more features can be recalled from the intermediate files. Commands on the terminal can change the selected segment and/or feature. A software generated grid over the map is an aid in this editing process. The grid makes the searching for specific segments in the intermediate files more efficient.

The questions of rotation, scaling and the actual storage of data is still under review. MNR is asking that the software take the original table coordinates for a specific map sheet and "adjust" them to a scaled, rotated, corrected, "absolute" dataset for a given map projection and scale. Thus the table coordinates should be modified for:

(i) the correct (real world) orientation of the map - rotation;

(ii) the correct (real world) coordinates of those features - scaled.

The scaling adjustment is necessary for two reasons. Firstly, the planimetric basemap's neatlines may not coincide when digitized with the calculated length for that map's latitude and longitude corners for that map projection and scale. The adjustment - to change the table coordinates of the basemap to fit the calculated mapsheet dimensions - must also be applied to any digitized Township boundaries. Secondly, the Township frame from the planimetric basemaps may not coincide exactly with the Township forest stand map neatlines.

Again, the digitized forest stand data from the Township map sheet must be "adjusted" to fit the corrected Township neatlines from the basemap. In this way we are starting with a calculated set of values and force-fitting the table coordinates to these calculated values, i.e. we use the map as a first approximation and then adjust its table coordinates to the "true" calculated coordinates for a specific map projection and scale.

In the interpretation phase the software checks and connects all the segments necessary to create the polygon as a discreet feature. "Missing" segments, or double representations of segments are flagged for the user's attention. In this process the attributes from the FRI computer tape are merged into the file. Thus any record, of any polygon, conceptually includes all the coordinates of its component segments, attributes describing the segments themselves, plus attributes describing the feature as a whole. These records are arranged into a very carefully defined format before loading into the file manager. The format and software processes of this "file manager" are common to GEOREF and FORMAGAIN. As such, when forest stand polygon data from OBM basemaps are incorporated with planimetric data from OBM map sources, the data should all be compatible and the thematic data should tie into the underlying OBM base. In FORMAGAIN, where the FRI planimetric base is used, the thematic data will tie into that FRI representation of the planimetry. As the FRI and OBM representations of the planimetry vary the two datasets will not coincide. It is presumed at this stage we will not try and fit FRI-based and OBM-based datasets together. More of this anon.

The FORMAGAIN System - Overlaying

Following field action by FMAs, certain measurements are taken of what actually was done (see Boxes 7 and 8, Figure 4). These data, which are recorded both numerically and with regard to location, i.e. on maps, are used in a variety of ways. Given the format of these results — attributes associated with linear or polygon features on FRI maps — it was possible to use these data to update the original FRI.

The ability to update was a very important component of the FORMAGAIN System design and the Guelph contract.

In general terms overlaying is to be used in FORMAGAIN in a variety of ways. These include:

1. Overlay of one feature class over another, e.g. ownership boundaries over forest stands.
2. Overlay of one theme over another, e.g. forest stands on soils polygons.
3. Overlay of one time of a theme over another time, e.g. update or true historical changes from overlaying forest stand maps of different vintages.

In addition this capability was to enable a user to do this for one or more specified complete maps, user-specified windows, and user-specified features within map files. It obviously leads into the "querying" capability described below in the next section.

Currently the FRI master copy maps and records (ledgers) are "updated" on a twenty-year cycle. The field office annually will produce cut-over maps and maps of silvicultural achievements. The field also tabulates in hand ledgers the areas and volumes depleted and detailed records of silvicultural projects. With the exception of the silvicultural project records (the SIS) all this work is manual. The record keeping is exceptionally vital, however, for three major management functions, namely control, understanding of results of achievements, and updating of the FRI. Similarly with FMAs, and given the trial nature of the FMA process, it is even more important to know what is happening and why.

Updating of FRI maps and ledgers (the attribute databank) manually is technologically possible but logistically infeasible without an army of clerks. Why not use a machine? However, the machine must be able to operate automatically for much of this process. A user deleting and replacing stand by stand, or segment by segment, would be useless. The process had to use polygon overlay and Boolean logic operators.

Currently in FORMAGAIN software we can overlay polygons of different complexities and determine which parts are overlaid and which are not. We can use the software with the colour graphic terminal and hatch the results of Boolean "AND", "OR" and "NOT". We have yet to transfer that to a whole map sheet and update for cutovers or burns "automatically", although the software does let you draw the cutover/burn over the forest stands and hatch those parts which are cut or burned.

The FORMAGAIN System - Interactive Inquiry

As inferred in the introductory remarks the forest manager is concerned with what he has to manage. Within that area, that Forest Management Agreement area, he may be concerned with a large area — a set of several maps or parts of maps. Or he might be concerned with a small area as in a window on a map or across two or more maps. Similarly he might only be concerned with a specific feature or set of features from the map file, e.g. only non-productive areas, or only mature pine stands.

FORMAGAIN called for the FRI data (map and its attributes) to be stored in such a way that interactive inquiry was facilitated. In the design stage we did not know, and still do not know, the exact type and frequency of such inquiries. However, they will be generally of three major types concerned with:

(1) actual or computed attributes;
(2) locationally dependent attributes;
(3) adjacency attributes.

Let us pursue each of these a little further. Actual attributes include the stand numbers, age, height, stocking, species, polygon type and others. These values are actually stored with the feature record. A typical forest management question would be:

> "Show me (on the screen/plotter) and give me a report (with user-specified headings or report type) on all stands in mapsheets X, Y and Z of spruce working group over 100 years, having stocking less than 50%, site class X or I, and area

between 20 and 250 acres." The forester is asking for the area (and perhaps volume) of stands eligible for cutting.

Computed attributes, which actually include area, length, stand volumes, also include the possibility for future estimates. For example, foresters assess height, stocking and other stand characteristics five years after regeneration treatment. Typically he might ask:

"Show me all the stands to be assessed within the next 3 years on maps A and B, and colour this year's red, next year's blue and the third year's green."

The productive algorithm could be simple (as above) or quite complicated.

The second major type of inquiry is concerned with locations. Locationally dependent attributes, which is perhaps a misnomer, includes a spectrum of approaches. We want to know what is within some specific "window" of user-defined location. The simplest approach is for the user to define the window or corridor on a hardcopy map, digitize it, overlay it on the total map file and then ask questions about the overlay. This is a link between inquiry and polygon overlay alluded to in the previous Section. A typical question is:

"What acres of jack pine have I lost in the burn of 1980 on mapsheet P?"

The burn was outlined on a map and digitized. This map of burn polygons of 1980 was then overlaid on the forest stand map P.

A second progression in the spectrum of approaches is for the user to define his window with the cursor on the graphics screen. With his screen full of the selected area of interest the user tells the system his sub-sample about which he wants answers. Such windowing capability does not presently exist in the software of FORMAGAIN but it is a user-oriented aid which needs to be developed.

The third progression in the use of locationally dependent attributes is built into FORMAGAIN at a primitive level. What I mean is that the

basic software for the simple version of the tool, or process, has been written. In this third progression the user identifies within his already selected environment (maps) on the screen certain features — roads, rivers, forest stands, lakes — about which the system will generate a "corridor" of user-specified dimensions. Again, an example will help explain this.

Cutting of trees within 400' of a road, stream, lake may be prohibited for one of several reasons. The forester must ascertain how much volume he foregoes with such a constraint. If he specifies which lake, which length of stream, and for what offset width — 400', 200', 1000' — the system will generate the corridor on one or both sides as requested around the feature specified. Merge this tool in with the polygon overlay capability and then come back and ask questions about this "corridor". Although the corridor generation tool exists its incorporation into a simple series of user macro commands has not yet happened. The corridor of user-specified width about a user-specified feature or segment can be done today with the FORMAGAIN software. Linkage with the polygon overlay capability is currently under development.

The use of this corridoring technology has special significance with Forest Management Agreements. If land presently within the FMA area is to be withdrawn from forest management practices there are certain legal implications. If the amount in any five-year planning period exceeds 5% of the area allowable cut, the Agreement holder receives some compensation from the Crown. The ability to quickly assess the effects of any proposed withdrawal is of considerable value to FORMAGAIN users.

Adjacency attribute searches, the third major type of interactive inquiry, are perhaps one area where the database approach scores over a purely graphics approach. Environmental and biological (silvicultural and wildlife) concerns can be considered if this adjaceny attribute search capability is in the system. The forester asks:

> "Where are the stands of mature pine which are <u>not</u> adjacent to cutovers?"

The enlargement of cutover area is against environmental policies, may create some wildlife habitat problems, and affect the microclimate for regeneration. Hence knowing what adjoins certain stands can be important. The database arrangement provides answers to this question.

One final point should be made regarding inquiry of FORMAGAIN. The FRI database is structured in such a way to facilitate two particular subdivisions of the Province. One of these is inferred in Table I. The second is a characteristic of MNRs organization. Let me explain.

First Forest Managers, Crown or company, work in management units (MUs) or working circles, or Agreement Areas (FMAs). Hence the first partitioning of the Province is into these Management Units. Foresters know in which unit they are operating. The subdivision within the unit is into forest stand mapsheets — basemaps or Townships. The mapsheet is a file. Within this mapsheet file the records cover features and their attributes, e.g. forest stands.

Inquiry typically follows this sequence of Province to Unit to mapsheets to features. A Directory will be produced to facilitate this searching, or identifying the part of the database of current interest. This Directory will contain:

Heading	Content
Province	List of all Management Units (name, code number, MNR administrative location, status in database). A map of the Province showing where each unit is locationally, e.g. as in Figure 1.
Management Unit (M.U.)	A list of Working Circles (if any) and all mapsheets in that unit (name, code number, MNR administrative location, status in database). A map of the MU showing the location of each mapsheet and working circle boundary.
Mapsheet	A status of this mapsheet indicating which themes exist, of what vintage, and which feature classes exist in any specific theme.

Using this Directory a forest manager can quickly define his area of interest. Even if the question originally did not specify which unit,

i.e.

"tell me (show me) what is in the window defined by these Latitude and Longitudes?"

the map of the Province with that window visually defined on a CRT would show the user which units were involved. He would then list these units and subsequently clip out the geographically defined window. The structuring of our data in this fashion facilitates the FORMAGAIN user. He is primarily concerned with specific Agreement Areas or maps within those Areas.

The second subdivision alluded to earlier is that following the existing Administrative boundaries of MNR. We treat them as an overlay — rather like a cadastral or ownership frame. As such a question calling for forest inventory data in Region Y or District X is handled like the geographic question.

"Show me what is in the NC Region?"

would set a map of part of the Province on the screen (that part defined by maximum/minimum geographic values of the NC Region) with the regional boundary lines overlaying the management units. Again the user would then input the desired management units, and the necessary mapsheets. At present this Directory and inquiry procedure is under development.

The FORMAGAIN System - Output

A display of the processes involved in the Guelph contract are shown in Figure 7. On the right side of this figure are the outputs. There are basically two types of user output. We have a graphic (map) and a report (tabulation). These outputs are to be produced on a CRT screen, a digital plotter or a printer at the user's request.

The major output — whether on the screen or plotted — is of two basic forms. The first, and initially the most important, is a map output that is comparable to the existing forest stand map, i.e. the System must be capable of output resembling the input. Some minor differences were requested like the area values printed out being derived

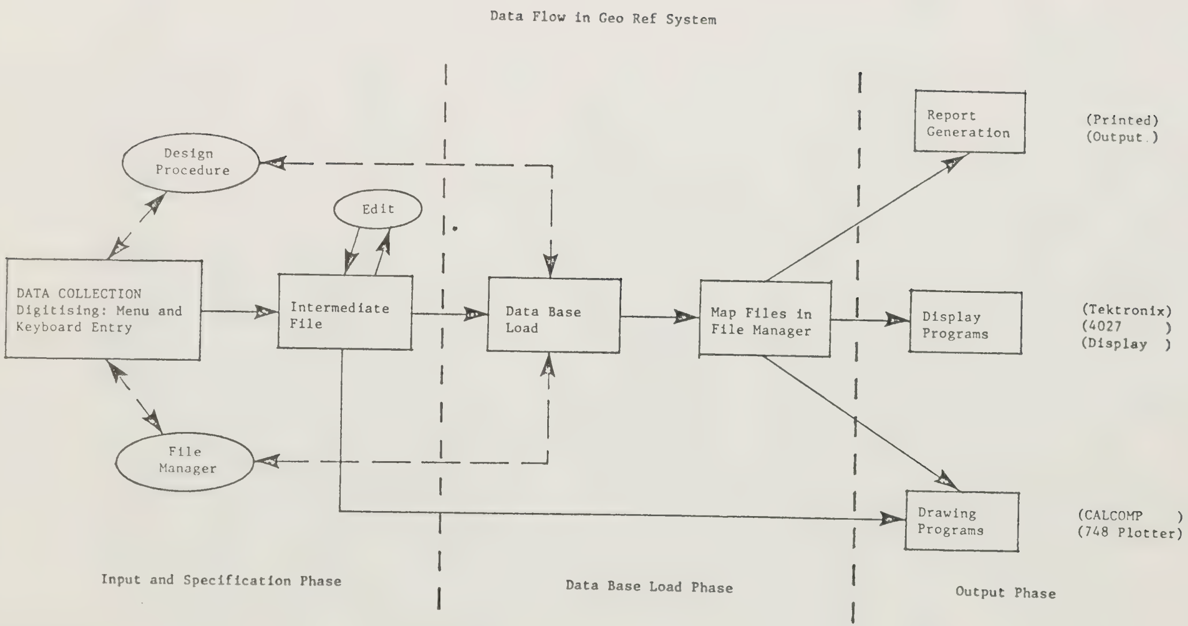


Figure 7. Sequence of events in FORMAGAIN as a GEOREF System.

from the digitized polygons and not from the attribute tape, plus the calculated geographic corners of Townships being printed on the stand map. Otherwise the plotted map from the System has to resemble the input document. At present in the System the software for this is virtually complete.

The second major graphic output is a modification of this. An important necessity in FORMAGAIN, and in forest management in general is the need to know where are the stands eligible for cutting and where are the stands needing silvicultural treatment? This "where" question needs to be considered in relation to current access (roads). Hence the Guelph contract called for the ability to highlight (colour, hatch) stands with user specified attributes, e.g.

> "Show me all the pine stands in map X over 60 years and all the spruce stands over age 100?"

This is an essential aid to the efficient allocation of the allowable cut and the building of access roads — see Step 4 of Figure 4.

Software for FORMAGAIN must allow the user the capability of outputting an entire map, a set of entire maps or any specified window across one or more maps. Within this graphic the forester wants to see all the feature classes he specifies. This includes showing on the map certain attributes which we do not show now on the original input sheets. For example the economics of logging are influenced by volume per acre but FRI forest stand maps do not show this attribute. Another plotting requirement is the ability to produce the map at a user-specified scale. It should be noted that the software of FORMAGAIN does include map projection transformation routines so we can produce FRI maps at 1:20 000 on a 6^{o} UTM projection if so desired. However, I would remind you that the forestry thematics are tied into the FRI representation of the planimetry. This FRI planimetry does not coincide with the OBMs representation of such drainage features, nor necessarily with the Federal Government's NTS map series representation. Hence, do not think you can easily or usefully overlay a transformed FRI forest stand map onto an OBM or NTS map sheet.

At present FORMAGAIN's software can plot out sheets at a variety of scales with user-specified features shown. Symbols come from a symbol library of the data dictionary so these are easily changed if the forest manager wishes to use any new symbols.

Software is also being developed which will flag map edge inconsistencies. With the aid of the gridding programmes these new routines let the user check features on either side of mapsheet neatlines. These routines check and let the user modify as required any feature which should traverse the mapsheet boundaries without distortion. At present this is being done on OBM maps where the grids are regular. On the FRI maps the gridding will be less useful and more difficult. Firstly, planimetric features and some thematic features have already been "adjusted" (matched) across adjacent mapsheets. In other cases foresters currently use township boundaries as thematic feature boundaries. Secondly, the grids for FRI maps will be square for each separate mapsheet, but will not be square over a set of mapsheets as in the OBM grid. This will make the software development more complicated.

Non-graphic output of FORMAGAIN will come from a generalized report generator. This has yet to be written. We do have the software, however, for two specific sets of reports. The existing FRI process results in a standardized set of ledgers (FRI Reports Nos. 2, 3, 4, 5, 6 and 7). A comparable set of ledgers was designed for FMA areas with some minor inventory differences. All the data for these reports are taken from the file manager. Hence by passing our data through the file manager including error corrections, better stand area definition and ultimately updated data we can still produce output reports in a format familiar to forest managers.

The FORMAGAIN System - the Workload

Initially FORMAGAIN was only concerned with Forest Management Agreement Areas. In the Feasibility Study of 1979/80 we had to determine the approximate workload of numbers of maps, areal coverage, numbers

of records, numbers of plans, numbers of records to be changed, and numbers and types of inquiry. As you can imagine in 1978-80 this was rather speculative. Over time some of these estimates have become firmer. With the signing of five specific FMAs we have been able categorically to count the number of maps, stands, allowable cuts and reports.

In 1980 as the FORMAGAIN software for data capture became more production-oriented we decided we could use this technology as part of the actual FRI process. Eastern Ontario's FRI is being re-established. The area covered is shown on Figure 1. Interest by MNR forest managers in Eastern Ontario reinforced this decision and some financial support was received from the Federal Government in the DREE Agreement for Eastern Ontario.

Photography for this area was taken in 1979 at a scale of 1:10 000. The areas were cruised for ground truth in 1980 and then interpreted photographs are to be transferred onto planimetric basemaps. We will transfer some of these results onto OBM maps providing we can get a complete management unit with OBM coverage. Otherwise we will use the already updated FRI planimetry. As mentioned earlier the data on the OBM base will not be compatible with that on the FRI base. A management unit cannot be made up of a mix of these two bases — that is impractical.

Once we have created the draught forest stand map we will digitize this as in Step 2 of Figure 4. The stand attributes will be entered into the database as a separate operation. Workload for this FRI process was relatively easy to determine.

A summary showing a part of the workload is given in Table II. The Table attempts to schedule the initial digitization database load phase and overall workload of FORMAGAIN for the first four years.

TABLE II

Workload of FORMAGAIN (1981-1985)

	Item	4-Year Workload	FORMAGAIN $ Costs
1.	Data Capture[1]	1,570 maps (427,000 stands)	$428,000
2.	Map Production	1,900 maps	40,000
3.	Allowable Cut Calculations	30 units	3,000
4.	Map Enhancement	1,900 maps	40,000
5.	AAC Allocation	30 units	25,000 (manual)
6.	Map Updating	700 maps (32,000 stands)	140,000
7.	Ledger Updating	32,000 stands	300,000
8.	New Map Production	700 maps	30,000
9.	New Ledger Production	30 units	on mini
10.	Report Generation	57 annual	on mini
	4-YEAR TOTAL COST		$1,006,000
	CAPITAL COST (Hardware plus Software)		1,046,000
		TOTAL 4-YEAR COST:	$2,052,000

[1]Typical 1981/82, 1982/83 details:

Source	Area(ac.)	#Maps	#Stands
Abitibi Iroquois Falls FMA	2,391,746	69	20,192
Eastern Ontario FRI	4,244,000	300	39,600
Great Lakes For. Prod. FMA	1,607,116	45	12,960
E.B. Eddy Upper Spanish FMA	1,749,892	82	33,631
E.B. Eddy Lower Spanish FMA	1,654,896	72	26,600
Spruce Falls FMA	4,070,958	87	33,938
Eastern Ontario FRI	2,816,000	200	26,400
Abitibi Lakehead FMA	2,867,210	101	31,860
Ontario Paper Black River FMA	650,182	36	8,500
Domtar Main Block FMA	2,739,200	55	26,540

The FORMAGAIN System - Status

Hardware

Currently we have five GTCO digitizer tables all big enough to handle our largest maps (42" x 60"). With each of these tables and its cross-hair free-floating cursor goes a DEC VT100 alphanumeric terminal. Editing is done with two Tektronix 4027 colour graphic terminals. All this equipment is linked to Lands and Surveys DEC PDP 11/50 via a multiplexor. Edit plots and small mapsheets will be plotted on a 32" drum plotter. This is on-line. Larger, and final plots will be done on a larger off-line drum plotter.

It is proposed in 1981/82 to purchase a separate minicomputer for FORMAGAIN. This will be a 32-bit word machine with tape and disc drives. All the FORMAGAIN peripheral equipment will be run off this larger minicomputer.

In addition we will purchase the CPU core of a remote station. This "pilot regional office" will actually be in Toronto and the hardware configuration testing will be done in Toronto. Typically this "remote CPU" could be a smart terminal or a small mini or even a microcomputer.

Software

On March 31, 1981 the FORMAGAIN contract at the University of Guelph terminates. During the last two weeks a series of acceptance tests will determine the exact status of this software. These tests will help us identify what can go into production mode immediately and what needs further enhancement.

There will be several software adjustments necessary. Firstly, MNR must acquire its own version of the UNIX operating system. When we purchase a 32-bit machine we will have a few changes from the 16-bit PDP11s.

The existing file manager needs some minor modification to accommodate the FRI maps because of their size. However, the basic format is the same as that of GEOREF for the OBM sheets.

Initially the software for FORMAGAIN is primarily concerned with FRI Forest Stand maps with an FRI base. All Forest Management Agreement Area maps are of this type. However, as described in the section on Workload above, some of the Eastern Ontario FRI sheets will have forest stands on OBM basemaps.

In addition to the software from the Guelph contract which is written primarily in the C language there are other pieces of software in FORMAGAIN. The OWOSFOP simulation package for allowable cut calculations is written in FORTRAN for a PDP10. When we get the new computer this will be migrated over.

Much of the software for boxes 8, 10, and 11 of Figure 4 is in the Silvicultural Information System package. This is written in COBOL and currently processed on the Queen's Park Data Centre IBMs. It has yet to be decided whether we will translate this or bring it across "as is".

Personnel

FORMAGAIN is to be a Unit within the Forest Management Information Services Section of Timber Sales Branch. The Forest Resource Inventory is the other Unit in this Section. In the FORMAGAIN Unit will be four major types of personnel and the supervisor. We will have an overall system operator who will be responsible for the technical functioning of all hardware and software — a chief mechanic. With this person will be one or two programmers as we pull the pieces into a production system. Interactive computer graphic experience with a knowledge of C and UNIX are vital skills needed by these people. MNR does not have these skills and two to three people will be hired starting April 1.

The other two types of personnel in the FORMAGAIN Unit are data processors and forest "managers". There is, and will be a permanent core of people who can take data through the entire system for any user. A key role of these people initially will be in training

potential system users. Finally, the FORMAGAIN Unit will see a never-ending succession of people learning how to use the system. Remember, as mentioned in the Introduction, FORMAGAIN is merely a means to an end. If it is to be a worthwhile "means" the forest manager must determine how useful this tool can be, and then learn how to use it. In MNR this will take several years as this technology is new to us. Furthermore, in the distributed locations of forest managers there are a lot of system problems to be resolved.

In summary, we are fortunate in FORMAGAIN. Currently we have a full-time consultant responsible for the synthesis and implementation of FORMAGAIN as a viable production system. Two programming staff from the University of Guelph team have been hired. In addition Dr. Raymond of MNR, who wrote the OWOSFOP routines, has become familiar with the components of the Guelph contract. We have had two of the original Guelph digitizer operators on staff in 1980/81 and they have also acquired complete operational knowledge of the system. They continue with us in 1981. Finally, the Steering Committee involved a cross-section of MNR "forest managers". However, there is definitely a problem in finding people with sufficient knowledge of both this specialized computer technology and the forestry application area.

The FORMAGAIN System - The Future

Technically I envisage six likely areas of development. If this tool is to prove worthwhile to the forest managers all six have to be put into practice.

1. The first technical future concerns the input. Hand digitization of maps has to be a loser. It is far too time-consuming. Already the Forest Resources Group have purchased a stereocord which will aid the development of digitization from aerial photograph stereo models. For input of FRI data in total, however, this is only a short-term solution. Ultimately we must develop a system of forest inventory data satisfactory for forest managers which can be entered into the database with little or no human intervention. Remote imagery with the data capture, interpretation and loading all being part of one automated process must happen if we are to keep the costs of forest inventory in step with the value of the resource.

2. The second "future" concern, the allocation of the allowable cut has already been mentioned. We will develop in the next two years a series of query command capabilities to allow the forester to determine the potential allocations and the practical subset. Given the number of maps and therefore the sizes of map files and features involved here the technical problem will be one of efficient searching and display following simple user commands.

3. An associated part of the allocation process is deciding on access patterns or more specifically, road locations. The actual decision is based upon a mix of factors including location and volume of aggregates, topographical features of drainage and contours, volume and quality of the wood, seasonal constraints on both logging and regeneration processes, plus the common thread of financing, availability of men and machinery. In the modelling of solutions to this problem computer graphics can play an important role. Obviously several of the above factors could be part of a forest management database and many of them need a spatial reference. A combination of overlays of soil type, allowable cut allocations, drainage and topography, and forest site types with a useful algorithm on road location economics will be developed. With the Crown spending up to fifty thousand dollars/mile and some roads on Forest Management Agreement Areas costing over seventy thousand dollars per mile, we think this development worthwhile.

4. A fourth technical enhancement concerns the recording of silvicultural achievements. In learning why certain stands did well and why others died, a sequential history of events is a useful aid. However, silvicultural treatments do not take place as a uniform event on exactly the same plot of land. Only by careful mapping of treatment areas and overlaying of a sequence of events can the true history of any forest area be determined. This technical development will

require procedures to input treatment areas from aerial photographs, probably 35 mm Supplementary Aerial Photography (SAP) and refine the query capability following a series of polygon overlays. It will also require better input on forest sites.

5. The use of word processing procedures is the fifth technical development. Some of FORMAGAIN's Plans contain tables and written sections which are updated and replaced at well defined intervals. The UNIX operating system does have some capabilities for this.

6. Finally there is the whole future spectrum of distributed data processing or not? Major users for FORMAGAIN are currently in Cochrane, Iroquois Falls, Espanola, Kapuskasing, Thunder Bay, Ignace. To come will be users in Fort Frances, Dryden, Red Rock, Terrace Bay, Manitouwadge, White River and other exotic places. How do these people put their data in? How will they take their answers out? How will they use this technology?

   There will be three phases to this future development. Firstly, in Toronto we will test a typical series of field foresters applications. This will include determining what software routines, what personnel training is required and what is the most appropriate hardware configuration. As described under the FORMAGAIN status the system operators staff will spend a lot of their time giving workshops to train foresters how to use this technology. Whilst this is happening some of the programmers with guidance from the Ministry of Government Services Telecommunications Branch will develop the necessary routines for remote processing.

   Once a pilot field station's procedures are developed in Toronto we will move the hardware, software and personnel to a MNR field location. There we will implement the software for remote access. The actual procedures will vary for different field stations.

In the third phase we will focus attention on improving the service for Agreement holders. This is still an uncertain aspect of FORMAGAIN. The exact mechanisms to be developed have yet to be formulated — a lot depends upon the interest or requirements of Agreement holders.

Coupled with this future implementation by field foresters is the potential for greater MNR usage. This could involve non-FMA Management Units. It could involve other resource managers in MNR, e.g. fish and wildlife, and perhaps even extend outside MNR. All I can say at present is that FORMAGAIN is so obviously in its infancy. The potential workload for forest managers and the systems staff of forest managers is enormous, always remembering it is still only a means to an end. FORMAGAIN does not put wood on the jack ladder, seed back in the ground, or increment on boles. These operations, done in an efficient manner to ensure the continuing economic viability of the forest industry for the benefit of the people of Ontario, are the top priorities of a forest manager.

FORMAGAIN - A SUMMARY

FORMAGAIN is a computer-based information system for forest managers on Forest Management Agreement Areas on Crown land in Ontario. It is a system whereby a manager knows the status of the resource, its inventory; the future intentions for the area, management plans, operating plans, allowable cuts; and the history of what has happened, assessments, records and reports.

The FORMAGAIN system was designed and developed as an aid to forest management. It is based upon the Forest Resource Inventory. The original Feasibility Study recommended purchasing and customizing a turnkey system, partly because of the lack of expertise in Forest Resources. This recommendation was not implemented and FORMAGAIN has been developed as a thematic application of Lands and Waters' GEOREF project and as such the software is compatible.

Technically only a part of FORMAGAIN has been developed as a computer-based system. The major part of the software written to date has been in the C language and has been developed using the UNIX operating system. Forest Resource Inventory maps are digitized to "load" the database. This database is kept current by digitizing changes to the FRI and processing the data by polygon overlay. Forest Management inquiries are handled by windowing, corridoring, and polygon overlay procedures. All software routines for FORMAGAIN are run in a minicomputer environment. Currently this is on a PDP 11/50 but it is planned to replace this machine by a more powerful minicomputer in 1981/82.

Brief reference was made to the existing workload, status and future of this System. With some 17,600 square miles under Forest Management Agreements already and another 5,200 square miles scheduled to be put under FMAs within two months there is obviously much to do. Although the overall design can be described as in Figure 4, it is apparent from my brief remarks that FORMAGAIN is still primarily a "paper" system. As a MNR production enterprise it really hasn't started. I can only hope it will realize some of the benefits within its potential. Knowing the pragmatic attitude, and language of its proposed user group I'm sure we will soon be told — very clearly. Thank you. (Applause)

CHAIRMAN IVES: Thank you very much, John. It is pretty hard for me to stay objective about a subject that is so near and dear to me and especially coming from a rebel, because I've often associated myself with being a bit of a rebel. However, judging from the response of the audience, everyone else thought it was a good presentation and I thank you once again.

At this point in the program I would like to ask the speakers who spoke today to come to the front or to arrange themselves at these tables for a question period. (Speakers come forward) Ladies and Gentlemen, the floor is yours. Are there any questions?

QUESTIONS AND ANSWERS

(Following Sessions Held on March 10, 1981)

Q: Mr. Gren Rogers, (INCO), Sudbury: Mr. Osborne, I was wondering, having noted that the wilderness areas of Haliburton and Algonquin are included in those areas which you plan to map at a scale of one to ten thousand, could you not include Sudbury? (Laughter)

A: Mr. Cy Osborne (MNR): I could include anything, but I don't have to make the decisions. I think that I pointed out that the priorities are set by an Interministerial Committee for mapping, and certainly if you want the Committee to look at it, by all means send me a letter and tell me what you want done. I don't guarantee that it will happen, but at least I can raise it with them.

Q: Mr. Mike Young (Topographical Survey, Canada): The question of digital data of course is the big issue here, and the production of it is probably a thing that is on many of our minds. The last speaker raised the point of manual digitizing in terms of productivity, cost and so on. Technology is now available in a number of systems on the market to automatically digitize by scanning and transforming the resulting raster format back to vector format by off-line processing of the scan data. We have test results which confirm the effectiveness of this procedure on single feature overlays such as contours and drainage, however, combined overlays cannot be effectively digitized automatically without excessive and additional effort in interactive editing and feature tagging which would probably exceed the effort to digitize manually. Unfortunately the reproduction material for most large scale mapping by provincial agencies is being produced on combined overlays and will thus be very difficult, and expensive, to digitize. Have you given this problem any thought as to how you might have your reproduction material organized in future mapping projects?

A: Mr. Cy Osborne (MNR): To answer this question from my point of view, yes, we have thought about it, but as to whether there is any immediate solution to it, since we do produce a monochrome map does raise a question. But that is something to come.

Q: Mr. John Kerr (MNR): I haven't seen a scanning system yet that provides the kind of intelligence required by most thematic applications. Generally a substantial amount of post-digitizing interactive graphic work is required to impart some intelligence to the "spaghetti" produced by scanning devices. There are, however, colour pattern digitizing systems which scan intricate patterns such as coloured polygons found on land use maps. The system automatically reads the colour and its location on a fine grid and transcribes the data to magnetic tape for subsequent processing. Additionally I know Environment Canada uses a drum scanner and has produced some very good maps. They can also do some interesting things with scanned polygons of land use data. However preparatory to scanning, separate manually-scribed overlays of the different feature types must be produced. The manual scribing process involves the same level of skill and takes about the same time to perform as does manual digitizing. Therefore unless separate scribe coats of each feature class already exist, why not manually digitize the features in the first place using procedures that will impart the necessary relationships and attributes to the digitized data? Besides, the processing costs to reassemble scanned data into linear features is still high. In any event, scanning limits the versatility of your digitized data and customized post-processing is generally necessary to provide relationships, compute areas, etc. Perhaps Dr. Linders would like to speak to this.

A: Dr. Jim Linders: I would like to duck that question. I can see technology evolving and I have certainly discussed it with other people. I don't think that effective scanning technology is around the corner. I can see a lot of work ahead before it becomes cost effective and reliable. I think that whether we like it or not, we are going to be stuck with simple manual digitizing for a long time. I do not see any quick solution unless there is a lot of money around the corner that will help solve our problems.

A: Mr. Mike Young (Topo Survey): You can take, for instance, a contour or a drainage sheet, and digitize it by scanning and vectorizing. We have recently had a contour sheet done with excellent results at a

very reasonable price. The problem of automatically digitizing a monochrome map is separating the features; there is just no way without a lot of interactive editing. If this is possible, the manual work that it would involve is horrendous and if the reproduction material is combined with the grid, it is probably impossible. The point that I am trying to make is that the reproduction material for the monochrome graphics that are being produced is incompatible with the automatic digitizing technology which is now available.

Q: Mr. Wm. Baker (Tourist Park and Recreation Consultant): I am concerned about the rather liberal use of the term "land related information system" as a synonym or equivalent term for "geographic data referencing system" and the exhorbitant claims for the exhaustiveness or completeness of the latter in relation to the information requirements of the decision makers in the natural resource policy, planning and management field. It appears to me that a geographic data referencing system is only one component of a total "land related information system" that must encompass equally important bibliographic referencing and abstract systems with which some substantive conceptual and operational problems are associated. Moreover, the temporal or historic dimensions of the situation, an aspect that we have not yet developed to the extent of the geographic, is of major consequence in many situations and at times is perhaps the significant factor. I believe that we should confine our attentions to geographic data referencing (sufficient unto the field are the problems thereof) and avoid the possibilities of needless controversies with other fields and disciplines by extravagant claims for the applied values of the tool.

CHAIRMAN IVES: Does anybody volunteer to respond? Or shall I pick someone to volunteer? Jim?

A: Dr. Jim Linders: Well first of all, sooner or later we will have to merge the various sources of data; whether we like it or not, the term "land related information system" doesn't turn me on either, but it also doesn't bother me. I think we are going to be faced with the job of

merging data, which has to be related to a base, and that base must be positionally related. My argument is that when we are looking at an environment data base, we view it as a utility to which we bring other data to the information system in order to do analysis and modelling, etc. I don't really see this as one big ball of wax; but rather I see this as a number of distinct entities all of which exist basically independent of each other. They share a basic environment which is the conceptional framework under which everything operates. I don't think it is a question of forcing everybody to conform to a given set of data standards. I see this as a problem of providing a working environment in which people can take their own data and relate this to position on the earth's surface and do whatever analysis is required.

Q: Mr. Wm. Baker: My point simply is that geographical data referencing systems are only one component of a total land-related information system in relation to decision making for natural resource planning and management.

A: Dr. Jim Linders: Yes, but it is the most important one. That is the thing that makes the data base unique; it is the one element that ultimately qualifies every item in the data base . . . position.

Q: Mr. Wm. Baker: While I admit the importance and value of geographic data referencing, I am simply entering a word of caution regarding excessive statements and claims that I feel are conceptually unsound and apt to lead to needless conflicts with other disciplines and interest groups.

A: Dr. Jim Linders: Well we can argue that later. I am not sure I agree with you.

Q: Mr. George Jackson (Agriculture & Food): I would like you to consider an agriculture aspect. Is there a real concern about building a bank of agricultural information that we can look at and then find later a

backlash from people not wanting to have data related to their operation placed in the bank? Do you see this as a problem?

A: Mr. Ruben Nelson (Square One): In general terms, yes. I think that there is some anxiety about computers. They are not all a gift. Security is one issue that is very important. It cannot be ignored. We really find ourselves in a very difficult position. On the one hand there are immense pressures to get on with these things; on the other hand we find that whether we like it or not, we are in a relational world. There are lots of other folks who are not in this room or even represented here, who have concerns that bear on what it is that we do and what it is that we can do. Somehow their needs need to be taken into account and talked through at the same time we are working through these developments.

Q: Mr. Richard Groot (Surveys & Mapping, EMR): I have a question to John Osborn and possibly others might want to comment on it. I believe that we are beginning to see, especially since we are now meeting for the second time with a large group here in Ontario, that this question of geographical referencing and the organization of geographical information in a way that makes it suitable for multi-purpose use is a quite formidable problem. At the same time there are extremely strong pressures on managers and people in government positions to give answers to difficult questions that could be helped by appropriate application of digital data management technology. These managers are often enticed or maybe impressed by the industry with nice demonstrations of interactive graphics, for example, and there is a tendency maybe to go that route without thinking through the requirements of the day-to-day management of the information including the updating processes and enforcement of accountability for the quality of information, and the secondary use of the information. It seems to me that possibly the forestry people in Ontario have gone through that cycle. When I listened to the explanation of the groundwork that was laid by MNR in the forestry area by means of the feasibility study and the recommendations for a turnkey system that resulted from this, the fact is significant that

these were not bought, for reasons that I would like to hear. (Laughter) Was it a case of a single-purpose system design that had to be reconsidered for multi-purpose application?

If they are now looking back, having gone through this process, do they feel now that this refusal was the right position? How much did the forestry user have to compromise to accommodate a multi-purpose approach? Many people are in that position now, and many unfortunately tend to go the turnkey system route without really asking the question: "Are we going the data base management route, or the graphics route, and what are the consequences?" Maybe others want to comment on this, but for me as a manager in the Federal Government, it is an extremely key point.

A: Dr. John Osborn (MNR): OK Dick, I will try, if I can unravel the lengthy question. First of all, the decision to go "turnkey" or the recommendation to go "turnkey" was made upon three main items. First of all, with the expertise within MNR we felt that we could get a better deal from a commercial enterprise. Get better training, better examples, be more hand-held than we would by trying to learn at our own slow pace in-house. So we were desirous to play in the nursery with this technology as foresters, to see whether the technology or the tools had any use for us at all. We did not know. It was all hearsay. We saw other people doing it and wanted to try. We felt the easiest way to try was if somebody came and helped us, a commercial company. That was one of the reasons for going "turnkey".

The second main reason for going was the georef product at that time was OBM based. As we learned this morning, OBM mapping didn't exist where forest management agreements were happening in Ontario, and therefore the development in georef using OBM maps did not do a great deal for the foresters. We wanted to use forest resource inventory maps and we did know in talking with the industry — the computer industry — that there were turnkey systems that could handle our FRI maps. So those were the two main reasons; an educational purpose and secondly the data that we had were not those being used at that time in georef. They were the two main reasons for us going to the turnkey system.

Now in retrospect, after two years, I personally feel that the foresters have perhaps lost a year or maybe two years of learning how to use that technology, if we could have gone with a turnkey system in-house. I am quite sure that any turnkey system at that time, and even now on the market place, will do what we are asking for, or at least do 75% of what I am asking for.

To come back to the data base for a moment. There were two or three systems that I knew of in the market place that were data base oriented. They use the same data base today, although not in the full way that Dr. Linders earlier referred to it, but they certainly are able to store the data in such a way that I could retrieve it for polygon overlay and queries such as I have alluded to this afternoon. I felt the foresters could have learned to use that technology or try to see if they could use that technology by going that route. We were not allowed to so do for a variety of reasons. One of them was a strong desire on the part of the Provincial Government to keep everybody on a georef-based system, and not have people diversify each in their own general direction. Now whether it is a good or bad decision I am not in a position to say. As a user, I think I have lost two years' technology; two years can really do a lot for you.

One other facet that perhaps people in the room are really not aware of is that foresters replace their data. In Ontario they have replaced their data now three times with a brand new set, with the update process I referred to earlier. And we were quite prepared to take the turnkey system, digitize our data, and five or ten years from now when the data becomes obsolete, then we take a brand new set of photography and re-interpret. We throw those obsolete data away, which is exactly what we do today. And by that time the OBMs will be complete up in the northern part of Ontario. At that time georef will have evolved into a practical on-going production system, and at that time the foresters will join hands, as in the strategy proposed by John Kerr.

A: Mr. Ruben Nelson (Square One): Could I just comment on that? I think that is an absolutely essential question, especially for those of us who find some of the technical things a little draining, particularly at this time of day. However there is no question where the future

lies. As I said this morning by 2001 there will be an information oriented integrated data based system. The question is not 2001 but the 1980s. What do we do now? Do we move to the future in one jump or in two? Ontario is exploring the possibility of one jump. But the question of whether or not this is wise for others is genuinely an open question, particularly given the growing sophistication of some of the upcoming turnkey systems.

Particular users are caught in a world of conflicting pressures. Part of it is the pressure to get on with a particular job right now. If one can meet 75% of certain needs now then tomorrow, given the kinds of developments that are out there now, we may be able to meet 90% by a turnkey system. You may be interested in the bench mark tests that were done on various turnkey systems in the Province of Saskatchewan. They were completed just about a year ago. The recommendation then was not to buy anything. Rather, the recommendation was to wait a while and then see if there was a system which could meet their needs. This way Saskatchewan does not have to put its own money into the development of software. At the least I want to be heard as making the plea to get that discussion between turnkey and custom designed systems more into the open and on the top of the table.

A: Dr. Frank Raymond (MNR): I would like to respond to some of the recent comments. Several people have mentioned "being swamped by information". The fundamental matter here is that, to me, they are using the word "information" when they really mean "data". Let us define information narrowly as that which is useful in planning and decision-making and which is obtained by distilling or transforming data. People rarely get swamped by that kind of information.

The available turnkey systems tend to handle map-related data more or less well but they tend to be data systems onto which it is not easy to add the part that would transform the data into information. The expanded result would be an information system. I don't think there can be one uniform information system for all users because the data-transformation-to-information part can vary so much among the different user groups.

I sympathize with John Osborn's point that we have lost a couple of years of training by having a system developed for us instead of purchasing a turnkey system. However, I am very hopeful that the data base system Jim Linders has developed for us will be one on which we can build the transformations that will convert it into an effective information system.

CHAIRMAN IVES: I think there is one more question — I see some people beginning to leave — we will have the one more question and then, there is another question period tomorrow. If any of you have a question and have not had an opportunity this afternoon, perhaps you could hold on until then.

Q: Mr. James P. Walker (Canadian Law Information Council, Ottawa): My question is general — it is kind of a resolution. About a year and a half ago on behalf of one of the provinces we ran a test where we took recently compiled line maps and ran them through a laser line scanner. We feel they were a very accurate set of maps. We then took some old fifteen eight-forty line maps — they had been around for years — and through overlay processing we put them all together and it didn't fit. To shake out the points and distribute the error we put it all together and overlaid, and the differences in it were a fright. When you start doing that, how do you propose to resolve these issues between two major ministries, a ministry that is affording to trust the future and in fact, a ministry that has predicated the delegation on old data and for the most part, inaccurate data? How do you proposed to resolve the matter?

A: Dr. John Osborn (MNR): I should have written one very simple solution that the forester's inventory is still a first approximation. It should be enough to print on every single map that he takes out "do not believe". (Laughter) That really is the issue. (Laughter)

Mr. Jim Walker: The group provoked by this particular project did just that. (Laughter)

Dr. John Osborn: And there was no collusion, was there? My other comment is primarily a note on the licensing or legal size of the problem. Perhaps you should be aware that although the lines are drawn on the map, the legal definition of what is within somebody's license is a legal metes and bounds description, and we, within the Ministry, have had some very rude awakening when the metes and bounds description does not coincide with the map. So it is a problem that is well recognized. I can't speak from a legal point of view, but I know the legal description of the boundaries gives us the greatest degree of reliability. Any surveyors in the room might question whether the metes and bounds description is not better than the map or graphic description of the boundaries.

CHAIRMAN IVES: Thank you very much. (Announcements) I would like to thank the speakers for the excellence of their presentations. I have heard many, many compliments that I would like to share with you on all of your presentations and you certainly have created a challenge for tomorrow's speakers. I would also like to thank the audience for helping me make it through the day and making my job as easy as it was. So from me, thank you very much. (Applause) With that I officially adjourn today's session. I look forward to seeing you again tomorrow.

MR. RICHARD GROOT, CHAIRMAN FOR MARCH 11, 1981 SESSION
DIRECTOR, GEOGRAPHICAL SERVICES DIRECTORATE
ENERGY, MINES AND RESOURCES CANADA

Good morning, ladies and gentlemen. Please take your seats. I should like to call the second day of the Second Seminar on Geographical Referencing to order. I am very happy to have been invited to share this session of the Seminar — it has given me an opportunity to meet many old friends and colleagues I met during my stay in 1974 and '75 here, and it is also very gratifying to see how much progress has been made since then. I am sure that you will agree with me that I am at a bit of a disadvantage — the very great performance of yesterday's Chairman, and the excellent session that she ran. I am also at a disadvantage because I am not a forester. (Laughter) Also, I'm not pregnant. (Laughter)

Yesterday we listened to papers on the future of geographical referencing and the management of information, and to the perceptions of someone who calls himself an outsider, but who by now is probably very knowledgeable in the field. We then listened to an update on the state of affairs with respect to the activities of the Interministerial Committee on Geographical Referencing, the Ontario Base Mapping Program, and today we are going to address the question of the need: "Who are these activities for?" Because after all, we may have very interesting and conceptually beautiful systems in mind, but there must be users out there that want such systems and desire a degree of standardization, which, by the way, I am surprised nobody questioned yesterday. I believe we have found in the speakers today, a very interesting cross-section to discuss this need. I have asked the speakers to shorten their presentations by a few minutes to provide an opportunity for questions immediately after each paper while the subject matter is fresh in your minds and you feel you want to react.

The day is structured in such a way that there will be a discussion period at eleven o'clock which focuses specifically on the need for a comprehensive geographical referencing data base. At the very end of

the day, all the speakers will be here in front to answer any questions that you may have, and I sincerely hope that the levity that Toronto usually brings to visitors did not detract you from doing your thinking about what you heard yesterday, so that you may have many questions.

The first speaker is Ken Richards who is a policy advisor in the Secretariat for Resources Development. He is responsible for the analysis and formulation of policies that deal with environment and land use. He has had considerable experience in these fields as well as the policy field in general. Ken has in the past been associated with the Department of Municipal Affairs and the Ministry of Treasury, Economics and Intergovernmental Affairs. He will speak on the needs of Provincial Government policy makers, pertinent to geographical referencing. I believe that this group is an extremely important clientele for geographical referencing capabilities, so I suggest we listen carefully. I would now like to introduce to you Ken Richards. (Applause)

MR. KEN RICHARDS: Good morning, Mr. Chairman, thank you. I find a seminar like this is a very important occasion. It enables users and those developing a system to gain a further perspective on one another's tasks; there is the opportunity to learn about a system at significant stages in its development, and an opportunity for the developers to be given some notion of when, where and how the users apply the product.

It reminds me of a story about an old lady. She was approaching her 90th birthday and had three sons who were well off. About a week before the old dear's birthday, the three sons got together and agreed to mark the occasion as a special day by buying her an extra-special birthday gift. So off they went to the stores. The first son, the eldest, bought her a limousine; the second son bought her a fur coat. The third son, having heard about the activities of the two other sons was at his wits end. What on earth could he buy his mother? So in desperation, he walked down the street of the town where they lived. As he looked into the shop windows, he came upon a pet shop. In the

shop window was a notice, "parrot for sale, can speak any language, says anything, $3,000". I'm not so badly off, I think I can afford this bird and its something Mother might appreciate" he thought. So in he went and arranged for the parrot to be delivered to his mother's house on her birthday.

On the night of their mother's birthday the three sons assembled around the dinner table. After wishing her the appropriate congratulations on her 90th birthday, they asked her what she thought of their gifts.

The old dear looked at the eldest son and said: "Well, you know it's very nice to have a limousine, but frankly, I don't go out very much any more". To the second son she said; "I really don't need a fur coat as I no longer attend social occasions".

The third son looked at her and said: "But what about the parrot?" To which she replied: "Oh, that was delicious". (Laughter)

The point of the story is that you won't get the best out of something unless you know what it's for in the first place.

THE NEEDS OF PROVINCIAL GOVERNMENT POLICY MAKERS PERTINENT TO GEOGRAPHICAL REFERENCING

MR. KEN RICHARDS
PROVINCIAL SECRETARIAT
FOR RESOURCES DEVELOPMENT

I am going to discuss two things this morning. First, I will describe the Policy Development Process in the Ontario Government. This will provide you with a general perspective of the environment in which policy is developed, some of the issues which are handled and where information needs may be most appropriate.

In the second part I will discuss the question of needs in a little more detail, and how these needs are related to the government's role in resources development. I will also attempt to translate some of those needs into potential themes for the geographical referencing system.

Turning first to the policy development process.

1. The Policy Development Process

Like all organizations in this society, government is faced with the problem of dealing with complex and rapidly evolving issues. Such issues touch many aspects of life. They may range from the government's role in the economy of the province, to the formulation of energy policies, or the provision of social services in anticipation of the change in the age structure of the population, to list but three which come immediately to mind.

In response to these questions, the government has at its disposal a number of ways of formulating alternative courses of action and solving problems. There is also a process in place to ensure policy direction. These taken in conjunction with the political process, constitute the system of planning and policy making in the Ontario Government.

Before describing this process in further detail let me attempt to define that elusive word "policy". The Oxford Dictionary defines it as "political sagacity, state-craft, prudent conduct, craftiness, or a course of action adopted by government". The Webster Dictionary is more explicit and defines policy as "a definite course or method of action selected from among alternatives, or a high level overall plan embracing the general goals and acceptable procedures, especially of a governmental body".

The current policy development process in the Ontario Government dates from the implementation of recommendations proposed by the Committee on Government Productivity which published its reports between 1969 and 1973. That Committee recognized the need to meet demands arising from rapid change and the increasing complexity of social and economic problems. It also recognized that the policy making capabilities of Ministers and senior officials needed to be improved. To achieve these goals, the Committee recommended the adoption of a carefully defined and rational process for setting priorities among competing goals and of evaluating program results.

As a result of the Committee's recommendations, the government initiated two basic changes. First, the Cabinet was reorganized into a hierarchical committee system, with each committee having a clearly defined role in the policy making process. A number of Cabinet committees were established including one dealing with the Policy and Priorities Board and others with the responsibility for issues in specific policy areas such as Justice, Social Development and Resources Development. These committees review policy proposals before the adoption of a final course of action by the Cabinet.

The second major change was the reorganization of the departments. This was implemented by first eliminating overlapping jurisdictions; second by the creation of ministries encompassing the new integrated element of former departments; and third the grouping of ministries related in function within the three policy fields.

The Committee on Government Productivity envisaged the policy making process to be in four stages:

Stage 1 — is the development of policy alternatives by a Ministry,
Stage 2 — is the evaluation of policy alternatives by a policy field committee of Cabinet,
Stage 3 — is for the proposed policy to be considered by the Policy and Priorities Board of Cabinet,
Stage 4 — is the approval of the policy by full Cabinet.

Until now we have been considering essentially a closed system, but the reality of the situation is quite different. The public policy making process is not self-contained within government but operates within a social, political and economic environment from which it draws policy inputs or demands. Here, notice must be taken of the various pressure groups or interest groups and their interaction with the government and with civil servants.

This, then, is the environment in which policy is evolved in the Ontario Government. It is a situation characterized by:

- different kinds of policies,
- policies which are subject to change and modification, sometimes fairly quickly,
- many influences brought to bear on policies as they are being developed,
- many approaches to resolving conflict or initiating action.

Government therefore depends on many people with different perspectives working towards the larger objectives of the organization. Seldom is a single perspective broad enough to encompass all factors involved in a particular decision. Information needs vary by ministry, department and the individual. In policy making the challenge lies in defining the balancing point between the effectiveness of the tool selected to do the job and the flexibility of the process within which we must work.

Of relevance to this seminar is the point that those involved in policy development require information and data in varying degrees of detail: they also need access to many sources of data and information.

Specific examples from the Resources Policy Field will hopefully clarify some of the general points made so far. They should also provide you with a greater insight to the many-sided characteristics of policy development.

The Resources Policy Field consists of the Ministries of Agriculture and Food, Energy, Environment, Labour, Natural Resources, Industry and Tourism, Transportation and Communications and Northern Affairs. The Ministry of Northern Affairs is a member of all three policy field committees. Briefly, the function of the ministries is to develop and implement programs in response to government policy initiatives. Each ministry possesses a group whose function is the analysis and development of policy. In addition to the ministries, there is also the Secretariat for Resources Development. The role of the Secretariat is to act as the coordinator of policy for the Resources Policy Field as a whole.

Generally speaking, the functions of those involved in policy development can be subdivided into four areas:

(a) Long term planning
(b) Problem analysis
(c) Program management
(d) Monitoring

(a) Long Term Planning takes into consideration overall patterns and trends. Based on the analysis of these factors ministries propose and develop programs and actions which may span a substantial period of time. The kinds of subjects involved here include:

- The preservation of foodland.
- Measures to mitigate the effects of acid rain.
- The development of policies to identify and preserve wetlands.
- Policies for outdoor recreation.

Most of these subjects relate to the Province as a whole.

(b)/(c) Problem Analysis and Program Management while these are separate functions, the factor which unites them in the development of policy is that they often involve a specific problem or an area. There may also be a multiplicity of jurisdictions involved including other ministries, other levels of government and interest groups.

In this area one might develop policies for such subjects as:

- the development of environmental management programs for lake basins or watersheds,
- an assessment of the impact of expansion by the private sector in certain localities,
- the selection and application of government programs to deal with special problem areas such as declining resource communities.

(d) Monitoring includes a range of subjects from the general to the specific. As priorities and issues change over time a vital part of the policy development process is the anticipation of change. Consequently, monitoring goes further than trend watching: it also represents the definition and analysis of emerging issues and an assessment of their impact on the government's policies and programs.

This description of the types of activities involved in policy development and the examples of policy issues in the Resources Policy Field serve to underline the point that information and data may be required from many sources and in varying degrees of detail before a policy is approved. Having recognized the variables of the environment, the challenge lies in the development of an information system which meets the requirements of a broad range of users.

2. Towards a Definition of Needs

The emphasis of this paper so far has been on procedures; how policy is developed and the functions of those involved in policy development. The next part attempts to bring us closer to defining the integration

of user needs into the Ontario Geographical Referencing System. Initially, it is necessary to review in broad terms certain policy directions of the government. Afterwards, needs will be identified which may be relevant in the evolution of the Geographical Referencing System.

In policy development it is important to be aware of "the big picture". That is, to have an appreciation of the broad themes influencing the involvement of government in society. At present, for example, the government's concern is to strengthen the role of the private sector and to support, where it can, initiatives to sustain further growth and development in the Province. This general theme underlies a number of program initiatives by the government during the past few years, the most recent being the establishment of the Board of Industrial Leadership and Development.

The articulation of this theme does not assist us in breaking down the problem into manageable proportions relevant to Geographical Referencing. Indeed, there are a number of steps involved in narrowing the field of alternatives before a specific answer can be given.

In narrowing the field, let us consider one aspect of the government's major fields of interest. Resources management and environmental quality are fundamental aspects of the government's objectives for the redevelopment of the economy. These are matters of concern to Ministries of the Resources Policy Field whose policies and programs are directed to assuring long-term supplies of natural resources, environmental protection and the wise management of resources. At this point we are much closer to defining what the overall needs of certain end-users may be, but not close enough to be able to clearly define specific needs to those responsible for the development of an information system.

Beyond this point lies the danger of becoming overwhelmed by the multiplicity of priorities and needs which make it difficult to provide a clear-cut answer to the question of what elements should be incorporated into an information system such as the geographical referencing. Beyond

that same point we also limit very severely the consideration which must be given to the needs of the private sector and the access it may require to data and information to assist in the development of its priorities and programs. At this stage communications between the developer and the user are essential. In the discussions between users and developers the users must be made fully aware of the capabilities of the system before their needs can be articulated, and, of equal importance, the developers should be attuned to trends in government policy.

Certain decisions have already been made about the Geographical Referencing System which should assist the avoidance of pitfalls. We are advised that the basic goal of the system is the orderly collection, storage and management of land related data. In implementing this goal it is intended to integrate survey information currently being organized as part of the Ontario Basic Mapping program and also to integrate information on different themes. I also understand that to date the scale at which the basic survey information is being coded is at the level appropriate to many uses in the public and private sector.

Jim Linders referred to the proposed system as a utility. I think that is a very appropriate term to people involved in policy development. It is one of many pieces of information to which access will be required in the future.

There are two important points from the past day which influenced my thoughts as a potential user in the Resources Policy Field:

- First, the data to be collected and stored will relate to the land,
- Second, the system is being designed to integrate information on different themes.

The proposed system and the goals of Ministries in the Resources Policy Field share one common factor: that is, an emphasis on the land. The

land and its features present, in varying degrees, opportunities and constraints for various activities. In addition, the realization of policy themes related to the economy and the development of resources requires a thorough knowledge of the resources to be conserved or to be developed and an awareness of the hazards to be avoided or to be mitigated.

Furthermore, the integration of information on different themes related to the land should enhance the decision-making process. In time, the availability of more accurate maps combining data on several natural conditions will make it easier to identify opportunities and constraints and to make the interrelationship between complex natural processes more understandable to non-experts.

From my perspective, therefore, the first priority for the thematic development of the geographical referencing system lies with the earth sciences. To be more explicit in what I mean, earth science information pertains to the natural materials, features and processes of the land. It includes geology, soil classification, hydrology and related scientific and engineering information. It, therefore, encompasses much of the information concerning the physical nature and interactions of land and water.

If the system is developed in the manner I am suggesting it will be easier in government to determine the physical merits of land for a specified land use and it will be a valuable contribution to the environmental assessment process. For the private sector it will enable developers of land and mineral resources to identify opportunities for further investigation. In other words, the interpretation of data and information involving the land should become less of a burden in the process of deciding the future development of a resource of a particular area.

There are two other topics I wanted to mention but time is running against me: to discuss the application of the geographical referencing system to an inventory of wetlands, and the other was the matter of

land use. In the time remaining I will limit my comments to information for land use planning, and land use information for urban areas in particular.

This topic has been the subject of debate for many years. Enthusiasm is not lacking, neither is there a lack of expertise.

One program which has come to my attention is the Regional Information System, or the RISC Program, which represents the cooperative effort of a number of regional municipalities around Toronto, the Government of Ontario and I think one Ministry in the Federal Government. These organizations are involved in the design and development of a comprehensive and compatible information system based on assessment records of the Ministry of Revenue. The area included in the activities of RISC may not be large in terms of the land area of the province as a whole but it is noteworthy that at least 70% of the province's population resides within the boundaries of the regional municipalities included on the Committee's membership.

The issue is whether we should press ahead with the development of land use themes based on the geographical referencing system under development or use the one we have in place at the present time. In terms of land use planning I find it difficult to reconcile the need to look at the province as a whole with the fact that 70% of the people of this province are already included by a data system.

Where do you place the priorities? The assignment of priorities among the themes of the Geographical Referencing System could be structured in such a manner as to satisfy other requirements before concentrating on land use, such as factors which may be of importance to the economy of the province. At this point I will stress the need for the value of communications between developers and users to establish the priorities. Some of the considerations in assessing those priorities will be the needs imposed by the development of the policy themes I mentioned a few minutes ago.

A further consideration is that in government today the emphasis is on making the best use of limited financial resources. We cannot afford to develop programs which may have a limited use in the short run. We must look for long-term advantages and those programs for which the returns give full value for the money spent in their development.

Conclusions

In conclusion, I think in coming years the challenge facing many of us in government will be to learn how to make up or change one's mind very quickly and learning where to look for evidence to support a decision. An important aspect of this challenge will involve the timely collection and analysis of information and feeling comfortable with the new information technology. I also explained that policy development in government is multi-faceted; it responds to different needs and problems, the process is complicated and the information requirements of the users are varied. In this environment, those of you responsible for the development of systems should assess the needs for information very carefully. Communications between developers and users are also very important as is the education of users. You need to tell us the capabilities and the limitations of the system in language we can understand, not jargon. There are enough difficulties unravelling problems and issues without having to learn another language. Thank you. (Applause)

CHAIRMAN GROOT: Thank you very much, Ken, for your words of wisdom and advice from the point of view of the policy makers. Are there any questions? Yes?

Q: Mr. Ralph Smith (Metropolitan Toronto): This is more a comment than a question. I get the impression that you want to say, and not too loudly, that your georeferencing programs deal mainly with the natural resources in the large land mass areas and, in someways, ignore the small land mass areas where 70% of the population lives. In addition, your programs may not be applied as quickly as you would like. I

represent a small land mass area, Metropolitan Toronto, and we recognized the need for a geographical referencing system in the mid-fifties. The present assessment type system does not cover our needs. There is a need to strengthen and expand the record keeping to create an urban information system for planning, administration and engineering. The urban emphasis is on the man-made structures which form the cities. These include utilities which have been buried below ground, over many years. Being in a natural resource ministry your main concern, as Mr. R. G. Code has said to me, is to cater to the needs of the foresters and land resource people. You must satisfy your own internal interests to get the georeferencing programs through the policy field. In the meantime, those of us concerned with the city environment are saying "Remember that man is building and producing in the cities and don't ignore the urban needs". In addition, don't belabour us with a traditional mapping system. We are already preparing and using traditional maps and know their weaknesses. We want to move on from a mapping system to an information system. Mr. Code has a difficult job, as Surveyor General, balancing the natural resource and urban needs. When holding internal educational seminars, to sell your programs, don't forget the needs of the 70% of the population that have been pushing, for many years, for similar programs to satisfy their needs. Urban areas don't want to be left as separate islands using separate assessment-based systems that are not compatible with their overall requirements.

A: Mr. Ken Richards: That is a good point. One of the difficulties in government is the current climate of fiscal constraint. In this context the development of information systems is an expensive proposition, so at the policy level, one has to assess where the biggest strides are to be made. If you look at it in the context of resources developments in the long-term and for the benefit of the provincial economy as a whole then one must decide between a number of competing interests in developing themes for the Geographical Referencing System. If there is an emphasis on geology it means information will be available to assist the mining industry. In terms of the provincial economy this may be a more important priority than land use. Speaking as a person interested in land use policy, I am interested in seeing that land use is reflected

as a theme in the system; in fact, I was quite excited when I heard what Jim had to say about it yesterday. How quickly that aspect of use moves forward is a matter that should be assessed in relation to other government priorities.

Q: Mr. Ralph Smith: We may move independently. We're spending our own money.

A: Mr. Ken Richards: That may be the best way for you. In fact I was talking with Klem Dembek from Sudbury yesterday and he had moved in that direction. You might want to touch base with him.

CHAIRMAN GROOT: I would like now to go on — thank you Ken — to the next speaker who is Andy Datlen, who is a cartographer — thank goodness! (Laughter) I'm glad to see you, Andy. Mr. Datlen has worked in the private sector in a variety of functions. He joined the City of Toronto Surveys Department where he helped to put in place a city-wide mapping system which includes almost the whole range of information that cities are interested in. He moved on in 1975 to the Computer Division to look at the Central Property Register and what could be improved there. I understand that he has just recently moved to the Ministry of Consumer and Commercial Relations to become Manager of Systems for the POLARIS Project. Andy. (Applause)

MR. ANDY DATLEN: Before getting on to the topic of geographical referencing systems, I must clear up a point which may cause a bit of confusion. As Richard said, I am listed in the Programme as working for the City of Toronto. At the time the programme was printed, I was. But I since have moved to the Ministry of Consumer and Commercial Relations, specifically the Land Registration Improvement Project, also known as POLARIS. For the next half hour, however, I will put on my former hat and speak as if I were still involved in municipal geographical referencing systems.

An amusing thing happened during the negotiations for my new position at the Province. Looking at the Land Registration Improvement Project

display at the back of the room you would really think they have put their act together. However, one of their biggest tasks is to assign an unique parcel identifier to every property in the Province. The first one they had to assign, which is my home address in order to send me the letter of acceptance, was incorrect — and I never did get the letter! (Laughter)

THE NEED OF MUNICIPAL GOVERNMENTS FOR A GEOGRAPHICAL REFERENCING SYSTEM

MR. ANDY DATLEN
MANAGER OF SYSTEMS, POLARIS
MINISTRY OF CONSUMER AND COMMERCIAL RELATIONS

The first thing to define is — what is meant by a Geographical Referencing system? If you were to ask fifty people for a definition, you would get fifty different answers, so I am going to tell you what I understand by the term, and what my talk will be about.

A Geographical Referencing System, from a municipal point of view, is a system where there is the capability to update or retrieve data using some geographic identifier, such as a street address, assessment roll number, or centroid, together with the ability to aggregate data over geographic areas such as XY co-ordinate polygons, planning districts, inspection areas, wards, etc.

The standard assessment file, which every municipality receives from the Ministry of Revenue, could be classed as a Geographical Referencing System under that definition. Records can be updated or retrieved using the assessment roll number as a key. Information can be aggregated over wards, ward divisions, or city blocks using various breakdowns of the roll number. However, the update or retrieval of data pertaining to areas other than those specified by the roll number is difficult, if not impossible.

Most municipalities have developed other computer systems containing data pertaining to land parcels, such as planning files, inspection records, building application files, computer aided dispatch information, etc. In most cases, however, whatever geographic identifier is chosen as being the main access key is the one they are stuck with forever, and whatever area district indicators are encoded into the records, are the only ones which can be used to aggregate information.

The use of secondary identifiers is often difficult or impossible, and the effect of area boundary changes is so disastrous, that entire systems have had to be abandoned because it was impossible to convert them.

For that reason, many municipalities have gone one step further in the development of Geographical Referencing Systems. Some have gone the very expensive high-technology computer-graphics route, where data is maintained by means of graphic images, or maps, on a graphic screen. These systems are almost always mini-computer based, and have the distinct advantage that plotted maps are available at any scale, and with various degrees of selectivity of information. They have a disadvantage, however, in that their data base organization is not suited to fast processing and retrieval of the non-graphic attributes in their files, and that matching of the data in these systems with large mainframe based files such as tax files, is difficult.

Other municipalities, most notably the City of Toronto, have chosen to add a feature to their standard land parcel based files which permits manipulation of the data for any desired area, makes the files independent of any arbitrary boundary changes, and permits access to records using a number of different property identifiers. It has the distinct disadvantage, however, that plotted maps cannot be produced by the system, requiring maintenance of a separate mapping system.

Computer graphics systems would take days or weeks for me to describe, and I am certainly not an expert in those systems. I will, however, describe the City of Toronto's Central Property Register as an example of the second alternative in the area of municipal Geographical Referencing Systems.

The system started out in the early 1960s as a group of unrelated land parcel based files, each one designed to perform some particular function for a particular department.

Slide 1:

Municipal Land Parcel Files

- Assessment and Taxation	*- 1961*
- Water Revenue	*- 1963*
- Planning Land Use	*- 1965*
- Building Applications	*- 1971*
- Housing Inspections	*- 1974*

First, in 1961, came the assessment and taxation file which was designed to automate the billing process for taxes so that bills could be sent out more often, so that the money came rolling in earlier in the fiscal year. The interest on that money alone paid for the first computer.

Then along came various other files, namely the Water Revenue File, the Planning Land Use File, the Building Applications File and the Housing Inspection File.

Slide 2:

Access Into Land Parcel Files

- Access to Water Revenue File	*- Water Account Number*
- Access to Building Applications File	*- Permit Number*
- Access to Planning Land Use File	*- Tax Number*
- Access to Housing Inspection File	*- Property Address*
- Access to Assessment and Taxation File	*- Tax Number*

As a group, however, these files could not be considered as a Geographical Referencing System because there was no way of linking records about a given parcel in these files, and no way of doing any kind of area analysis, other than that permitted by whatever geographic area identifiers had been added to the records.

Slide 3:

Geographic Area Boundaries

- *Federal Government Census Tracts*
- *Wards*
- *Water Districts*
- *Housing Inspection Areas*
- *Planning Districts*

all overlaid together in a mismatched conglomeration of boundaries.

The problem is, of course, that there is a multiplicity of geographic areas in a city which are constantly being changed, with new ones being invented all the time.

Slide 4:

Early Attempts at Unification

The aforementioned Land Parcel Files with a unified street address enquiry screen using cross reference files to translate a street address into the file access key.

A first attempt was made to link some of these files by means of a uniform retrieval screen, and cross reference files, which permitted entry by street address. That did not work properly because of the multiplicity of street addresses used to describe any given land parcel.

Slide 5:

Property at the Corner of Grange Avenue and Beverly Street

Slide shows all the addresses for the property,

- *namely Nos. 94, 94A, 94B, 94C, 96 96A, 96B, 96C, 98 Beverley Street, and 4 and 6 Grange Avenue.*

Fortunately, a programme of street address enforcement had been started a couple of years earlier, coupled with a continuously revised mapping

system which provided an inventory of the 150 years of street addresses which were already out there.

Slide 6:

Property Data Map
A map showing street lines, properties municipal numbers, and the flow of updates from municipal departments having information which keeps the maps up to date.

From these maps, a Master Address File was created by means of digitization which captured every known street address, all their aliases, and the XY position of the approximate centre, or centroid, of the property.

Slide 7:

Master Address File Digitization
Slide shows a digitizing table on which is mounted a property data map, a keyboard into which the municipal address is entered, and the resulting file of co-ordinate and property addresses.

At the same time a maintenance system was put in place to keep this Master Address File up to date as properties and centroids changed.

Slide 8:

Master Address File Maintenance
Slide shows the amalgamation and severance process as properties change, and the way in which the Master Address File is maintained by means of MERGE and SPLIT commands.

Now, at last, there was a true geographic area retrieval capability where data could be retrieved from the files corresponding to any geographic area.

Slide 9:

GEOGRAPHIC AREA POLYGON RETRIEVAL

Slide shows a geographic area is defined as polygon co-ordinates, a polygon analysis program which extracts the properties inside the polygon from the Master Address File and a comparison program which extracts the corresponding records from whatever land parcel file is required.

Over the years from 1976 to 1979, all the previously unconnected files were linked via the street address to the Master Address File. During the same period, there were changes and revisions being made to the various sub-systems to support this.

Slide 10:

At Last — A Geographical Referencing System

The aforementioned Land Parcel Files with a unified enquiry screen, with the Master Address File being used for access into the other files.

During 1979, the street network file containing the utilities data was linked to the System.

Slide 11:

The Street Network File

Slide shows pavements, sewers, poles, watermains, traffic, transit, slidewalks, future construction, etc., all linked to the Master Address File.

All this material was very nice to have, but the City of Toronto could probably have muddled along in the old way quite a while if it had not been for a series of events which forced the City to accelerate its geographic referencing programme.

Those events were the passing of a complex series of By-laws which totally reformed the zoning fabric of the City.

Slide 12:

Pictorial Obfuscation
Slide is an actual example of a zoning map attempting to depict years and years of by-laws and amendments affecting properties, illustrating the complexity of the city zoning.

The end result was that it became nearly impossible to figure out and discover all the pieces of legislation passed over the years which might affect a given land parcel.

The Master Address File, at the heart of this Geographical Referencing System allowed the fast creation of a complete zoning file where all the legislative items were applied to whatever land parcel they affected. Polygons were defined which described the boundaries of the legislative areas, and computer programmes did the work of figuring out what properties had to be updated.

Slide 13:

Zoning File Creation
Slide shows how the polygon analysis program takes zoning by geographic areas, uses the Master Address File to figure out what properties should be updated, and then creates updates for the Zoning File.

So the end result, which became available in January, 1980, is a linked system of land parcel files which can be updated or extracted by means of single land parcel identifier, or by any arbitrary geographic area.

Slide 14:

The Central Property Register

Slide shows a number of Land Parcel Files:

- *Assessment & Taxation*
- *Water Revenue*
- *Building Applications*
- *Zoning Legislation*
- *Property Sales*
- *Planning Land Use*
- *Proposed Developments*
- *Property Inspections*
- *Health Inspections*

and non-land parcel files:

- *By-law Text*
- *Street Information*

linked together by means of the Master Address File.

A connection has also been made between the zoning legislation file and the corresponding text, so a user can enter a street address, ascertain the By-laws which affect the property, and then read the By-law text which is merged onto the screen, together with the other zoning information.

During the last few years, the Geographical Referencing System known as the Central Property Register has satisfied some other needs of the City of Toronto in addition to those mentioned. Among them are the analysis of real estate trends in various areas of the City, the development of a computer assisted dispatch system for firefighting equipment, the study of municipal tax reform, and, to a limited degree, some thematic and demographic map display.

It does not yet, however, provide land parcel or street network mapping in any form, although work is currently going on to add this capability.

The question is still open, however, as to whether it is better to go the computer graphics route, where you have full flexibility in

displaying maps and pictures, but some difficulty in processing the non-graphic information, or whether to go the route the City of Toronto did, where a data base file management type system with geographic components satisfies your non-graphic requirements, but does not give you any pictures.

The organization of land parcel records by geographic area makes a lot of sense when you want to display maps. However, all the computer graphics database systems I have looked at do not really solve the problem of features crossing the boundaries of those geographic areas. A dangerous trend is taking place in that computer graphic systems are starting to be used to store large amounts of non-graphic, operational data. When such databases mature, it is conceivable that the queries made on the non-graphic attributes will greatly exceed the requirements to display maps. General queries on operational data require fast sequential processing of files, at least on current computer hardware. To process such queries when these non-graphic attributes are distributed over thousands of map files will take forever.

For a number of years, municipalities have had such a need for geographic referencing systems, that they, in the absence of any leadership from the Province, have had to develop their own. The two main areas of geographic information — that is, physical information and cadastral information — rightly belong within the two ministries, MNR and MCCR. Yet the City of Toronto was forced to develop its own mapping system, and its own geographical referencing system for its own purposes. Metro is doing the same. So is the City of North York. This work has been underway since the 1960s.

Finally, the two sleeping giants, MNR and MCCR, are starting to respond to these needs. Unfortunately, for many urban areas, it is probably too late.

This reminds me of a quote, with which I will close my talk. It is by the late Indian leader, Mahatma Gandhi:

He said: "I must go now;
For there go my people;
And I am their leader."

(Laughter and Applause)

Q: CHAIRMAN GROOT: Is there time for questions?

A: Mr. Andy Datlen: Maybe one or two questions and then, if I still have my job at MCCR, I'll put on my new hat. (Laughter)

Q: Mr. Wm. Baker (Consultant, Ministry of Industry & Tourism) I am Interested in the historic aspect of the master file and how far back do you go on property changes? And do you link them to the original survey?

A: Mr. Andy Datlen: No. We started at the time we digitized the map, which was somewhere in 1975 and we went on from there. There was no possible way to go back through the 150 years of records — often there were no records — and try to find out how that land came into being.

CHAIRMAN GROOT: Are there no other questions? Well thank you very much Andy, for an excellent presentation. (Applause) I think the crux of what Andy has been talking about is with respect to the graphic systems that are extremely attractive, on the market ready to buy for graphics purposes, but these then evolve into things which are much bigger, for which they were not designed and I think that that is a very important message. Thank you very much again, Andy. (Applause) There is coffee now, and please, could you be back in about ten minutes — we're running a little bit behind time.

— COFFEE BREAK —

CHAIRMAN GROOT: OK, ladies and gentlemen, I would like to re-open the session. We will continue with a paper by Dr. Jim Linders of the University of Guelph. He was introduced yesterday, and I will not

enlarge on the introduction except to say that Jim and I have been associated in this subject matter of geographical referencing and automated cartography, I believe since 1969 and it has taken me a little while to understand what he was talking about, but I can assure you that it is becoming abundantly clear to more and more people that the kinds of things he was saying in the early seventies with respect to the requirements of geographic information systems and associated data based management are becoming very true and that he has been proven, in my view at least, very accurate in his prognosis and in his statements of requirements. His subject is "Toward the Design and Development of a Comprehensive Geographical Referencing Data Base for Ontario". Jim, would you please come forward. (Applause)

DR.JIM LINDERS: Thank you Dick. It is encouraging to know that I'm getting through at least to a Dutchman. (Laughter) Again I am going to try to keep the discussion as simple as possible. One of the concerns I do have is that often I speak to some of my colleagues at the University and other such technical groups, and I know that the level of dialogue that goes on is somewhat different than people who are just being exposed to the subject matter. Since it is difficult to effectively address everyone simultaneously I would suggest if you want more discussion about the details, then come out in the question period, or if you really want to become involved in technical discussions then we can do that after my presentation.

TOWARD THE DESIGN AND DEVELOPMENT OF A COMPREHENSIVE GEOGRAPHICAL REFERENCING DATA BASE FOR ONTARIO

DR. J. G. LINDERS
DEPARTMENT OF COMPUTING AND INFORMATION SCIENCE
UNIVERSITY OF GUELPH

I am going to try to walk through this material relatively slowly and try to create the type of scenario that I see evolving for geographical referencing. Again it might have been more appropriate if my chauffeur had done it instead of me, because he probably has more to say as to where it is going than I do. I can give you some idea of the trends that are evolving and that will relate very much to what Ruben said yesterday. As I said yesterday, I feel that Ruben and I are sort of soul brothers, because I see this development in georeferencing going in a given direction and the effect of what is happening in our society, specifically the relevance of information and the technology to support it, is somewhat guiding this development as was suggested by other speakers as well.

Now what I propose to do today is to say just a little bit on each of the following topics, namely data base design and a little about the user interface, because that is something that is of great concern to everyone. One of the problems that we as computer scientists face is to make these systems more approachable, and as the computer scientist would say, more "friendly". I am also going to say a little bit more about geocodes, again because it is essential for understanding where we are going with georeferencing.

Let me summarize what we talked about yesterday and really look at where we are and where we are likely going. When we talk about georeferencing, we are really looking for a common information system. The thing that is of importance is the information. It is not the data and it's not the products that are derived from the data, because they are secondary. The other thing that is important is that we are not looking at a single information system, as Ruben implied yesterday. That is not the way that

one can visualize or view georeferencing. It really is a utility, and in the sense of being a shared resource, it provides a number of functions for a community of users.

The way we seek to build this utility is essentially by means of a distributed data base. I will say something about the data base concept now. The data base is really the technology that underlies the information utility, and the way we achieve a distributed data base is by means of some inter-connection via some teleprocessing technology. They are not part of a georeferencing development. The data base technology is a separate technology that is used to support georeferencing. As well, the teleprocessing technology is also a technology that is used to support distributive processing and this methodology is currently in place. I also said that georeferencing represents a formal system. By a formal system I imply a system that has structure. There is organization to it. It can be described and defined in a formal manner, and therefore, it is easy to enhance and gain access to it because the rules are essentially well defined. In the same sense this is similar to formal mathematical systems. Their utility value lies in the fact that they are extensible. We must see the data base in the same way.

John Kerr mentioned yesterday the need for standards, because before we can have a data base, it is important that we have a set of common conventions and a common nomenclature for dealing with the various entities in the data base. These standards relate to not only the data base entities, but how we share these entities amongst the community of users. He also said that we are really working towards a notion of an information utility, and that is the essence of georeferencing. It is not a specific computer system and it should not be seen as that, because the time will come when that underlying technology will be supplanted or replaced with new technology, but the aspect of georeferencing would still be in place. One could argue that we have georeferencing today, but the technology is a manual technology, and we are aspiring towards a digital technology and that in time, further down the road than I can see at this moment, it might be replaced with another technology. Now there are some ideas about what is likely to happen, even beyond the year 2001, but this is not particularly relevant at this time.

Again carrying on from the theme of yesterday, I said that if we are going to talk about georeferencing we have to talk about shared resources, and these shared resources constitute not only data but function. We must look at a set of resources which are common across the whole community of users, so everybody must see the same capability. The way we solve some of the problems that Andy Datlen related to is by the means of having a common resource where you bring your data to the system environment, and you integrate your data with other people's data, perform the necessary logical checks to ensure its consistency within a data base environment, and perform the functions that are implied on that data base. Now this implies, as I said, the integration of the thematics with the base, because if we don't have registration, we have nothing. Instead we have a number of disjointed file systems and the problems that are associated with correlating this data in such an environment are truly legend. The only hope in georeferencing is that we can evolve standards; we can share the environment by means of integration. And then, I still maintain we are talking about a land mass information utility of which georeferencing is the term we are using for it today.

Now let me say a little bit about the data base environment, and talk about the sort of things that we have to concern ourselves with. If we look at the operational aspects of a data base environment, this gets into the question of who runs what and how we run this type of distributed resource. There are a number of support functions that must be spoken to. The first one is that of a data base administrator.

The role of the data base administrator is really quite clear. In essence he is the architect of the system and has the responsibility for the integration of various data entities within the conceptual framework in which we are working. He has control of the way in which the data is used and in the way the data base is built, but outside of that he is peripheral to the operation. In fact, he performs the same sort of service that any regulatory agency performs, whether it is a police force or a government agency. His role is really to ensure that the

environment is maintained and administered according to the rules and conventions that are set down for the operation of the data base. This implies that there is somebody somewhere who has the final say as to how the integration of the thematic data with the base data is achieved. This is an administrative aspect of a policy or design.

There are also technical support problems that one has to look at. In order to achieve the type of environment necessary to share information, functions and resources, we have to talk about both hardware and software. My perception about the hardware aspect is that the technology is in place (I'm talking about computer communications, not about building new communications networks). There are existing communication networks in place today that we can tap into. For example, the Telidon system represents a particular information utility built on an information packet switch network, such as Data Pac. GEOREF would use the same kind of resources and is not intended to be something that is over and above this. In terms of the physical hardware, at the moment I happen to use a DEC PDP11/34 computer, but the system itself has been developed independent of any particular hardware system. Nowadays we have isolated ourselves from the hardware by high-level languages so that hopefully the system is portable.

In terms of the software, the question that people often ask me is: "How do you see georeferencing evolving in terms of the diverse mandate that each agency has?" The answer to that is that the various components of georeferencing are essentially sets of libraries, and these libraries are truly portable. In the same sense that we have a set of standards, the software which constitutes libraries are themselves sets of standards. The file management system is something which is at the moment in software, but could very well be in firmware, which is something between hardware and software, namely micro-code. We are not looking at special purpose systems whereby we develop software which has to be maintained by each individual site. We see this as a set of common resources. And of course in order to make this work, we do need standards.

Let me say a little bit about the data base design. As Cy implied yesterday, there is a data base, which is implied in terms of the file manager. The file manager pre-defines the organization, storage and management of land mass related features. When one looks at a data base, we look at first the information content. It is important to know what and how to encode it. As I have already said, if we have learned anything from our experience of the last year and a half, it is that there is a lot of other information which is implied in the graphics. It may not be so apparent to the user, but if you really want to perform some functions, much spatial information has to be derived. It can be defined by encoding at data capture time, or it can be derived by analysis. The latter is a hopeless task.

We also have to talk about data organization. I said to you yesterday that some applications require building complex structures and hierarchies of structures to provide the function that is required. Within the data base design, one has to look at how you build structures to meet the needs of various applications. The way in which this is achieved is by means of a data based management system. The data base management system we have in place today represents a set of functions. These functions are used to realize the various applications.

The information structures are complementary to the data base management system. The combination of information structures and data base management system essentially defines a data base capability which the user sees in the form of an information utility. Then, of course, there are a lot of maintenance functions which must be considered, one of which is to provide backup in terms of maintaining a recovery process.

There is also a set of utilities for interchanging data. We have not interchanged data with the people in Ottawa yet, but we are at the point where we could certainly give them files of data that we have and have them use it within their system.

The question of how we deal with update is one that will be addressed at a future meeting. Let me say a little about data based components and then we will talk a bit about some of the concepts. When we talk about a data base we talk about first a data dictionary. The data dictionary implies the semantics of the data base. It tells us what is in the data base and what meaning the various terms have within the data base itself. We look within the data base; we need some mechanisms for being able to interchange information — moving data from one part of the system to another part. If we talk about a distributed system, this is particularly important. For example, if we look at a specific mandate area, one may wish to access information that is found within somebody else's file system. It is necessary to build up the necessary data interchange protocols for achieving this. The actual mechanism by which we get in and out of the data base is by means of access schema. I will give you a simple example in a minute to illustrate what I mean. Within the data base, we have a data bank of file systems, much like Andy Datlen described in his presentation. Essentially what Andy was describing is the type of process that goes on while evolving the data base, and it is the same thing that has been occurring in many other applications of the last ten years.

I have addressed the role of the data base administrator and the notion of how we define the data base itself. It is also necessary to have some understanding about the notion of schema and sub-schema. In order to really use a data base a user must have his own perception of the data. This logical perception of how the data is manipulated towards a given end forms a logical model. In fact that perception by a user is of the relationships that exist between data. These may not be found within the physical data system itself, but may be virtual elements or derived data — essentially implicit information that exists between the explicit data items within the data base. I know this is a hard concept to understand, but you can relate that to our everyday thinking. Each of us has a model of reality in our own minds and not all models are the same. We all have access to information, and the way we use that model of reality in conjunction with the data, says

something about how we do our own mental information processing. We are doing essentially the same thing with an information system, and it is that process that is meaningful in the context of creating an information utility.

The schema represents the various levels of description between the user and his data. I can best illustrate this by a very simplistic example of a data base schema. If we look at GEOREF itself we have, as I said yesterday, a universe of discourse — to use academic terminology. That means there is a set of things we talk about. The things we talk about within the data base are features. We talk about features and the way that we get to the features is by means of a feature directory. A feature directory identifies various classes of features, then we get down to a particular table for a given class. If we are looking for contours, we first reference the feature type directly from a data dictionary. The data dictionary tells us that there are contours; the feature directory would then direct us to where the class of contours is located. Finally, a feature table describes all the contours and from the feature table we locate the feature code record which contains all of the information types associated with the feature. The feature itself can be segmented (this is a recursive process) and the segment itself may in turn be a feature. This is how we build up information structures implied earlier. I said we keep various types of information about features; we keep its positional aspect; we keep its attributes which are user defined; we keep text (for example as in the case of toponomy we would keep the text associated with the name); we keep its associations, namely the relations that that feature has to all other features in the data base. We can also keep its geocode; the geocode is another information type that is stored with the feature. We keep information about its representation as something that is associated with the type of product we are to produce.

Remember that each segment is treated as a feature. The feature will have all information types associated with it, and every segment of that feature could also have this type of information associated with it. Essentially this is a simplified schema of the data base that

tells a user what he can expect from the data base. If we have to extend the data base, we can add more information types. Actually there are others which I haven't told you about but it is easy for us to extend this definition if one identifies a new type of information that should be maintained by the system.

A sub-schema relates to how a particular user accesses the data base and how he uses the data. The sub-schema is really the access path. Consider how we gain access to the information associated with the feature. In a very real sense this is not a true schema, but hopefully it conveys the actions of what a sub-schema is. It shows that once we locate the feature, then we access the segments in turn which then allows us to access each record type in turn. This may be repeated to any level required.

In order to achieve the above we provide access mechanisms (i.e. functions), that allow us first of all to: (a) locate a feature; (b) identify the information type we want for that feature; (c) get the data items or the data values associated with that particular information type. When talking about a user interface, we have to talk about how the user gains access to the information. Again, in a very simplistic sense, in order to relate to the individual application areas each user would have to know how we gain access to the data. The mechanisms for using the system are first of all, one needs access to the data dictionary, because the data dictionary tells us everything about the data. The command structure is used to invoke various processes for doing specific functions, e.g. plotting, entering data into the system, editing, etc. These commands are directives to effect some specific actions in the system environment. There is also a need for a query language. The query language pertains to the locating and retrieving elements based on conditions and attributes. Finally there is a need for modelling. Modelling, for example, is used to investigate the facts of various scenarios without really modifying the data. Essentially the user builds a logical model of a specific reality and investigates the consequences through simulation.

Let us now consider the user interface. At present we have a set of commands. We haven't done anything about structuring these elements of the user interface in such a way as to make the system friendly. At present it is still necessary to have a directory of commands, as well as know the sort of functions that are built within the system. It is proposed that within the next ten to twelve months a friendly interface will be developed which will provide the user with easier access to the system. When we talk about a user interface we are talking about, first of all the set of conventions and standards that provide access to the system. Nowadays the computer scientist doesn't build fixed systems, he builds information utilities. With such systems, once you sign on, the system should lead you the rest of the way.

To have an effective user interface it is necessary to have mechanisms for explaining the conventions and the standards the user needs to gain access to the data within the system environment. This is part of a common set of resources. Included there are also the functions that I talked about yesterday including polygon, overlay, editing procedures, various data collection procedures which are implied in the data base itself, etc. This is a common dynamic environment because it is constantly changing. The capability seen in the system today is constantly being enhanced as more functions are added. During the next year or so it will be necessary for us to enter into dialogues with various potential users, and describe to them the system capabilities as well as the various levels of user interface to the system. At the highest conceptual level we will have a friendly interface and that user level language is really natural language. Most interface systems today are aspiring to use natural language to the maximum degree possible. Unfortunately English itself is rather ambiguous, so there are certain things that one has to stipulate as a set of basic conventions. Below that there is a data sub-language which is a set of directives within the system to move data from one point to another point, as required, to reference the data within the file manager, etc. At the very bottom are the actual functions themselves which are the data base functions. I would suggest at this time that all of the latter is completed, because we are working from the bottom up. Some

of #2 is completed and nothing of #1 is completed. So the task that we face is to define this user language or this user interface to permit convenient access for the casual user.

Most of us in dealing with information systems associate a query language with any specific information system, and the normal format of a query language is something like the following: There is a key word followed by some condition, followed by some qualification. For example, a key word could be "locate". The condition may be, all the rivers within a given geographic area. The geographic area would probably be described as a geographic polygon. The qualification might be a condition such as "all the spruce within a given region". This is all a part of the query language capability. Last but not least, we have to talk about some means of referencing, and that ultimately boils down to a geocode capability.

Again let me briefly say what modelling involves. Modelling is the particular form of access, in other words, it is a particular form of user interface which is concerned with logical access for the casual user who wishes to examine the facts of certain relations on the data itself. In other words, he postulates a given model; he then examines the effects of the data on that model and derives or infers information from it. Essentially what we are really doing is creating the conceptual framework which allows the planner to approach the system and, firstly, establish a rapport with the system, because what he is going to do now is find out what data exists in the system. He is then going to define a number of relations which constitute his model of reality. Next he requires a facility to invoke some type of capability, which is normally a set of functions, for investigating various scenarios. For example, the foresters are interested in knowing the amount of wood they can remove from a given area based on conditions that are associated with corridors around the various roads and rivers, etc. This is essentially a modelling capability. However before we have a modelling capability we need a very extensive data base and this implies collecting a lot of data.

I believe that for land use planning, we have a big job to do before we have enough data to be able to effect the type of functions that I suspect the land use planners will require. However, we must think towards that end at this time. Now the simplest type of user interface that we can think of is commands. Commands simply tell the system to do a specific action. For example, one can recognize commands like digitize, plot, edit, save, locate, etc., and they tend to be invariant; they tend to become very fixed high level functions within the system. They are clearly all in place now because the only way that we could collect data is by means of the software processes that we have written. This is probably the simplest aspect of the user interface.

In summary, what I have said about the user interface is that there are many aspects to it. At the highest conceptual level there is the user interface, which means his vehicle of communication. It has to be something as close to natural language as possible. In some cases the user has to learn the key words, because the commands are not going to change. There are other aspects of the user interface which deal with modelling, and one has to talk about mechanisms of allowing the user to describe what he wants to do in terms of the conceptual model, and investigate various aspects of this. One thing that I did make constant reference to was the notion of being able to locate, reference and manipulate, by means of some sort of handle, information within the data base. This relates to the notion of a geocode. We have implemented the geocode modules, and they are in place and we have used them. The reason why I am always reluctant to say too much about geocodes is because I fear a great desire on the part of users to go out and start building geocodes, and I am not sure we can handle this yet without a lot more experimentation.

Let me tell you what we have been doing with regard to geocodes. Our perception of a geocode is that it is a system-generated encoding of a feature, stored as a data base entity. We can build a geocode for anything that has meaning to the data base. The geocode is not a fixed thing, it is not static, it is something that depends on the

type of entity you are talking about. The geocode for a point is clearly much simpler than the geocode for a line, which itself is much simpler than the geocode for a parcel, which itself is much simpler than the geocode for a network. In the same way that we describe a parcel, we want to be able to talk about a network. We want to be able to reference a network, and there must be an encoding of it as well. The very fact that we must maintain these information structures now means that we must have a short form or a synoptic overview of that same data base entity.

As I implied yesterday in the question period, there are various components of the geocode. The first component is really a definitive element which describes its type and certain key attributes. Essentially what we have is a formatted vector. In the first part of the formatted vector, we have a list of relevant attributes. For example, if we were to look at a geocode for a contour (and it does have a geocode), we would know exactly how to interpret the format of that vector. The first element would be the definition element; there would be certain key attributes that we would keep in that formatted element, and we would use this information within our retrieval mechanism. The next thing is that there are other elements that are computed elements. In fact, what we are really seeking are the invariant aspects of a feature, because they uniquely characterize or identify the feature. If I look at a lake, hopefully the area of the lake is more or less constant, constant within a predefined tolerance. If the lake area does deviate somewhat, this is looked after in the search mechanism. Now whether that particular lake is represented in a Lambert Conformal projection or represented in a UTM grid, it is still the same lake — it still has the same area. So area is an invariant that we are looking for. We look for perimeter or length, that is something that helps to characterize a feature. We look for the maximum and the minimum x and y values. Again we store these and they constitute the second element of our geocode.

There are other elements which are derived elements, and they represent various moments and various metrics which are measures of the information. I don't want to expand on this, but obviously it is important to

get some measure on topology. We need some means of encoding topology, and it is this part that we really haven't experimented with. We have experimented with moments when, for example, we do retrievals using a statistical model based on Bays theorem (an evidence system based on mathematical statistics) in order to match a target geocode with a search geocode. Essentially we are locating a feature by creating a geocode for it and searching for the feature within all the geocodes of the data base. So far this has produced very high hit rates, certainly well beyond 98%. Again we are working with very limited data. In order to make this meaningful, and in order to be able to correlate data from, let us say two different sources — for example, ERTS imagery and something else in the data base — then we must have a much larger and more extensive data base. Clearly this is something that requires a lot more experimentation. Our success to date has been very positive, and we hope within the next year to look further into this area. The important thing is that the geocode for us is machine generated. A user cannot see it — he has to be able to give us the parcel and identify the parcel in the language or in the format that is convenient to him. The important thing is that it is transparent to him; it is managed by the system; it is used by the system for simplifying or expediting the access to the particular feature.

Let me say a little bit about futures because I think this relates to what is happening, or where GEOREF or similar utilities are going. Some of this overlaps with what Ruben Nelson said yesterday. What we are really looking at is an information network, and many examples of such information networks are in place today. Telidon is one. I can see the day when GEOREF becomes part of Telidon. This means providing access to information which is found within GEOREF so that it is available to the community of users.

The next thing I see is essentially an evolution of the GEOREF capability. We are really moving from data management to decision support systems. That is what the new term is for management information systems, or long range planning, or planning for resource management, etc., whatever you want to call it. This is an evolution that has been

going on over the last ten years. We have moved from file systems, to data bases, to information utilities. The reason for the development of information utilities is because we need them to be able to support the type of decisions we have to make in our various mandate areas today. I see that occurring more and more. In fact in speaking to Ruben Nelson, and he mentioned it in his talk as well, he said he could see the day when we would replace hierarchies by networks. I, too, believe that because I think the way we will communicate information amongst ourselves is by the electronic medium which is the computer; the way we will share information between mandate areas is via the information utility which is the computer system itself. This doesn't mean going across the arbitrary demarkation lines we have between mandate areas today. I see other things happening that were also alluded to yesterday. There is clearly talk about an enhanced technology base in which we move from our conventional line-following devices to raster scan input and output. I certainly believe it will happen. I have some ideas how it is going to happen, but it is not going to happen in a matter of two or three years. We are probably looking at five years and beyond. We are looking at enhanced graphics, and some of the things that GEOREF is trying to do today really involve this type of enhanced graphics that allows us to deal with feature conflicts so that when two features conflict with each other in a graphic, we would like to be able to resolve that without the operator. That is possible only if we have the necessary information structures. The reason why the user can resolve these conflicts is because he has spatial perception. Now that we keep much more information about spatial structures, I believe we will be able to do this within the computer system. Next, I see us extending our knowledge base. The sort of things that are happening in the computer environment today is truly encouraging. Even I would never have anticipated that ten years ago we would be moving away from our conventional Von Neuman view of a computer system which was as a single computing engine. Today the type of things that are being done in terms of using the computer system to perform many of the diagnostic functions that are required for analysis of systems or even human beings, is truly encouraging. I believe that the type of system that one is

evolving in terms of an information utility gives some promise of essentially enhancing the capability that we have for managing our resources and using positionally related data that we have in the various Ministries today. (Applause)

CHAIRMAN GROOT: Thanks very much, Jim. Ladies and gentlemen, we have now three-quarters of an hour to discuss the need for comprehensive geographical referencing data base. Having listened to speakers yesterday and this morning, the word I think we should underline is "need". The second thing we should think about is, if there is a need, how strong is it, what stands in the way of fulfilling it, and how much commitment is necessary to fulfill that need? Inevitably a lot of questions have come to my mind.

First of all, listening to Ken Richards speaking about the policy process and the decision making process of government I should like to know how real their requirements are for GEOREF. We all know of many examples where in spite of the tremendous intellectual efforts of policy makers, Ministers often make decisions that are not exactly very strongly related to the policy options put before them without a great deal of help from geographical referencing systems. And I think I am saying that as softly as I can. (Laughter)

Secondly there is the question of standardization and comprehensiveness, and in the public perception as it is represented by our MPs you should realize that maybe the public is not interested in governments collecting more information, or for governments to have the capability to more effectively manipulate information. That is a barrier in my view. I do not believe that the trend today among the population is to embrace further standardization. I believe that is a barrier. There is also the question of credibility, which was alluded to this morning by Andy. Where were the Ministry of Natural Resources and the Ministry of Consumer and Commercial Relations when they were needed by Toronto, when it was faced with its problems? Toronto went its own way. Also, you go back to the graph that Cy Osborne showed yesterday which represents a more than ten-year period. This has to do with credibility as well,

because ten years ago the Committee on Government Productivity identified clearly in its report that there is something fundamentally worrisome with the investment the Province makes in collecting information and the effectiveness of this information as it is used. And how far have we come in ten years? Many systems are still put in place that are unrelated and I am sure that the road will be still pretty long and arduous. So why comprehensive? We've come so far — all right, I guess. Politicians still make decisions. There are complaints about information overload, so why more? Are we going to create a tower of Babel by putting Telidon terminals in everybody's home and office, and we will have more information access? What are we going to do with all that? When the initial enthusiasm is over, what is this Telidon terminal really going to do? Of course it's like a toy. At first you want to have answers to a lot of questions, and you use it for maybe five weeks and then it sits there, and what really is it going to do for us? So the problem of credibility is, in my view, quite considerable. Ministers were told in the middle and late sixties that all you need is to put everything on computers, and you will have the information at your fingertips to make decisions. That's what they were told by industry and by enthusiastic university professors. (Laughter) And in those days there was a lot of money around and we made many big systems. So when we now go forward with an idea about comprehensive and compatible systems, we should not be surprised to have a rather sceptical reception, because this is going to cost a lot of money and take a long time to implement. Furthermore, it will take a lot of time for it to really pay off. The question is, are we too late? Should we just let it roll along as it is now? Should we do nothing? It is those kinds of questions that came to my mind when I listened to the presentations which I believe have been truly excellent.

To begin with, I would like to invite people to react to the kinds of questions that I have raised here. All of you, or at least the majority, must be working with systems. Many of you are probably here because your systems are not working too well, and you are maybe looking for magical solutions. I would like to ask Ruben Nelson to make some

comments on the questions that I have raised and then I invite you to join the fray. Ruben, would you like to speak to this?

MR. RUBEN NELSON: Thank you, Dick. It's an invitation that I suppose one dare not turn down. And for those of you who know me, there is not much chance I would anyway. That sheet that Dick had is useful. One of the things it says to me is that in spite of the ups and downs, slowly over time the way we approach and see things does in fact change. That is one of the underlying facts of our situation. Whether we like it or not, our understanding of the world and our consciousness of it, and of ourselves and our immediate environment, is in fact changing. But I think Dick's sheet shows how it happens. It is not a nice smooth graph. I know certainly from my own experience as an in-house consultant for the Federal Government that you cannot go to the Treasury Board in Ottawa, or I suppose to your own Management Board in Ontario, and argue with them that the ontological foundations of western culture are changing. Do that and you only last one round! (Laughter) The difficulty is, though, that over a fairly long period of time and its several generations, that this in fact is the case. There is even one Deputy Minister in Ottawa who could write a ten-page essay on the changing underlying trends of our culture and how that relates to his particular mandate.

But I want to intensify the problem. There are examples from our history, when we have been aware of change, that we have been trapped because we have moved too quickly. We have abandoned what we had too quickly and moved into a new technology. But . . . there are also examples of being trapped because we have continued what we had and have not moved into a new technology quickly enough. I want to give just a couple examples of each, and it does no more than intensify the problem and maybe sharpen our consciousness.

On the one hand, for example, IT&T in the USA has now calculated that had they made a substantial commitment to satellite transmission ten years ago, they in fact could provide better telephone service in the

US at a cheaper cost than they can now with a largely land based telephone system. And they recognize the reason they did not do it ten years ago is the fact that the technology was so new that they were too nervous. They saw the satellites as kind of R&D for the future, but not for now. But as they look back today, the satellite technology would have been cheaper had they made the change ten years ago . . a hard, hard thing to know.

One can also look at it the other way around. One of the obvious examples is seen in Toronto. In most cities in North America one had electric street railway systems. They were abandoned, of course, under pressures from bus manufacturers including General Motors. But we now discover that had we stayed with street railways and upgraded that technology, in terms of the cost and efficiency we would have been far better off. Toronto is the only place in North America that kept its street cars.

Let me use an example. In the '60s we could not distinguish growth in the economy from growth in the school systems. Both were growing, therefore we assumed that both would grow forever. Now in principle I suppose an economy could grow forever. But in principle school systems cannot. Schools depend on children being born year by year. So the capacity to distinguish one situation from another is immensely important. It really comes back to good judgment. Part of the difficulty is that there is no litmus test for good judgment.

Let me finish with a story which just does no more than intensify the situation. It is a story that happened about this time of year in the springtime when a lot of the snow had gone but there was still snow beside the road. A chap was coming down to a conference much like this. He wanted to find out about digital mapping. As it was a pleasant day he was riding his motorcycle. As he was tooling along the road he ran into a snow squall and he began to feel uncomfortable. Finally he stopped his bike and turned his jacket around so his collar could come up under his chin. He zipped it up the back and felt a little better. So off he went again. But he hit a patch of ice and went off the road and into a

big pile of snow beside the road that had not melted yet. Well in the next scene, the OPP have arrived and there is a stranger standing over the inert body. The OPP said: "Is he dead, or is he all right?" "Dead," said the stranger. "Dead," said the OPP, "how could he be dead? It's only ten feet from the road and there's snow and it's all soft from the spring thaw — what's the matter here?" "Well, I wondered that too, and so I felt under him and wondered if there was a rock in the snow, but there is no rock. Then I noticed that his head had been turned right around, and by the time I got it back again he was dead." (Laughter)

There's a moral to that story. The moral is that we really face a choice. That either we can continue with that sense that we really know what we are doing, and in the process turn other people's heads around to what we now are sure is the truth, or we can spend a lot more time working at getting our own heads turned around so that they are adequate and then moving on together. Thank you. (Applause)

CHAIRMAN GROOT: Thank you very much, Ruben. I am glad I asked you to enlarge on these questions I had. I have noted that in the audience there are a number of people from other Provinces who are deeply involved in the type of work that Ontario organizations are now reporting on. I wonder if any of them would like to give a short description of what is being done in their Province on this subject? Paradis or Bramsdayor — I don't know the name — expose? (Laughter) Have we made them? (Laughter)

M. MICHEL PARADIS (Energy and Resources, Quebec): Well, if you don't mind, Dick, I would like first to comment on what the previous speaker has just mentioned. I was quite pleased with his address yesterday and some of the things he mentioned. But if anybody is interested in what is going on in Quebec, I will add something.

I think the key word in our discussion up to now is the word "information". Thinking of the sense of this word, it came to my mind that it has two different meanings. We use the word information when we enquire,

when we get ourselves informed of something. This is the normal first step in a conscious approach. I would like to point out that we are today so much submerged by information that information has become a problem in itself. Mass media brings information to people, they are more informed today than ever, but being informed is not enough to bring consequent action. There is an information gap today. The second meaning of information is given by its etymology "in-formation": to give a structure to something. This is the creative part of the word. How to use the technologies available to create something really new is much more difficult. To inform is more difficult than getting informed.

CHAIRMAN GROOT: Thank you very much. I believe that certainly is one of the concerns I have. While I was in Toronto several years back I had the incredibly fortunate experience to be able to go to Dr. Marshall McLuhan's seminars. He had a certain perception of new technology as a medium, and in order to distinguish patterns — patterns that Ruben Nelson probably alluded to — his position was that the first thing a new medium does is accelerate what we already have, and when we are overloaded with what we already have, we begin to ask the question, why do we have it? And then the true questions that really pertain to the new medium are being asked, you know, what can we really do new? And of course what McLuhan postulated is that you don't really ask that — it is being forced on you by the medium, and it happens by itself because we have to adjust to it. At any rate it reminds me of this whole setting here, that we are dealing with a new medium and we really do not understand yet what it can do for us. I know Alberta has representatives here; do they want to say what is happening in Alberta on the subject?

A: MR. KENT MEISNER (Alberta): I represent the Land Related Information Systems Co-ordination Project, Alberta Treasury, which has, for the past year and a half been studying the need for and the means to provide on-going co-ordination of the development and use of land-related information systems. I see this as very much akin to what is being undertaken here in Ontario but using a different approach. I will not attempt

to compare the two approaches. In Alberta, the nature of our problem was identified and somewhat documented through various efforts spanning the past eight years. The chosen approach was to create a project mechanism which would provide the necessary solutions and relate those to actions required to achieve the long-range goals. Presently, our final report is in the hands of a policy level committee from which should stem recommendations which hopefully will go to Cabinet.

A very major part of our project effort has been to address the current on-going requirements of the various departments of our government. What I have not heard about today, or yesterday, are the needs of the user community which presumably are the force behind the Ontario effort. In Alberta, we have attempted to identify existing needs first and foremost. We have inventoried the public and private sectors, we have met with a range of sector representatives to assure that we have taken the proper direction and we have tried to involve the users in our project through keeping them informed. An important aspect of the Alberta project was the recognition of our problem being a business problem with the solutions being those which address government's business of the day in ways which would benefit both the public and private sectors.

In a more specific sense, we have recognized that developments are occurring very rapidly with technology advancing such that it is almost hopeless for one person to keep abreast of all the changes. During the duration of the LRIS Project, we have been involved with departments who are applying the leading edge of advancing technology and in a number of instances we have been instrumental in bringing departments together to share their experiences, reducing expensive mistakes and ultimately co-ordinating developments in areas where the impacts go beyond their own departmental needs. Automation of our Land Registration Systems represents one particular example of where significant advances are being achieved. We have structured a subsidiary project, the Alberta Land Registry Project, which has now been underway for several months. It involves two major participants, Energy & Natural Resources and the Attorney General, as well as a number of other

departments that are very much implicated by what happens. We have capitalized on the move by the two major participants to automate their existing land registry systems. Simplistically, the Alberta Land Registry will reflect the existing mandate and programme responsibilities of those major participants and most importantly, the value of the information within those respective systems to a much larger community of users, not as single sources of information but as accessible, compatible and complementary sources of information. The Alberta Land Registry will also form a key component of an overall network of Land-Related Information Systems for the Province. As an aside, I should say that I have been left with the impression, and I must say that I have trouble accepting it, but that your thrust here in Ontario is towards one large system. Now, to my point which is that we see a network of systems evolving. This network will assure that component systems will be able to talk to one another, that there will be a high degree of access to individual systems provided to both the public and private sectors with the usability of the overall information base being developed according to need. That, I feel, sums up what we are attempting to achieve in the long run.

Q: CHAIRMAN GROOT: Thank you very much. I am rather eager to have someone speak to the impression that you have because I can understand that one takes that impression away — that somewhere some central thing is being built, some one system that is all things to all people, and I wonder, Jim Linders, if you could speak to that?

A: DR. JIM LINDERS: First of all, let me say I am a little downhearted. I thought that we had made it clear that we are not trying to build a single utility. If anything, we are creating an environment where people share data and I think the only way you can do that is by conventions and standards. A good analogy is really the electronic fund transfer that is in place today. The banks all have their own systems but they have a set of common conventions or standards for sharing data. And that is the environment that one perceives as being possibly viable for Ontario. The systems will be different — there is no question about that. We heard yesterday about how forestry is taking a

particular approach — I have to be very careful about this — they are taking the geographical referencing system and they are turning it into a customized system, but within an environment, hopefully where everybody can share the forestry data. There isn't a single system and there never will be a single system. You could never get people to agree to that, but there is the common environment that people share with common resources. If we don't get that, we are certainly wasting our time.

Q: CHAIRMAN GROOT: Can you give an example, sort of a parallel, of what you mean by that? You know — common environment?

A: DR. JIM LINDERS: Electronic fund transfer . . it has forced the banks into an information utility. There are now standards for internationally doing the fund transfers, so we don't move cheques back and forth; we move information. The same thing is applied here. It is rather straightforward to me — I guess it may not be as straightforward to others. As soon as we establish a common medium and a common set of conventions for exchange of information, then the rest will follow naturally. Today what we have is a number of disjointed file systems each of which is perceived as being entities independent of each other and we operate that way. We do not intend to continue this way because of the mammoth amount of information that we have, and there is a need for interrelated information. It is this need that is going to force us into a common utility environment, otherwise I do not think we will be in business any more.

Q: CHAIRMAN GROOT: Thank you. Another aspect that seems to come through fairly strongly is the need to communicate on the part of the people who want to design and implement this comprehensive system to communicate with the user, and although yesterday I made a not very complimentary reference to the private sector, the commercial firms that sell equipment and software, I think that it is incredibly important that the equipment and software sector be included in that communication and I wonder if there is anybody here from that industry who wishes to speak to that? There is either nobody here or they don't wish to speak. (Laughter) John, I didn't know you ran a business on the side! (Laughter)

A: MR. JOHN KERR (MNR): Before we leave the subject of a comprehensive system, I would like to reiterate what Dr. Linders and others have said so that it is clear we are not talking about a single facility under one roof, where all this data will be stored on one computer system. When we talk about a "comprehensive" system we are talking about many things including a common referencing grid, a systematic series of base maps, a systematic series of grid cells, data dictionaries, feature classifications systems, general purpose computer routines for performing common tasks; we are talking about standards for expediting the transfer of digital data. These are all parts of the "comprehensive" system and most of them will have to be put in place before we can begin to interface different systems. We believe that any organization which has the mandate to capture, store and update specific information should maintain their own data. They have created their own base of data. They are the ones that know the purpose and functions of it and have developed the expertise for using it. No one wants to take the base of data from anyone; all we want to do is develop means and ways of effectively referencing and accessing it in order to get more use of positionally related data and expedite its transfer between those who have it and others who want to use it.

I believe it was you, Dick, who mentioned earlier that we now have lots of information and the information base is continuing to grow. Part of the problem is learning how to effectively manage that data. We have to be able to selectively retrieve it from different sources and combine and compare it with other data in order to answer a variety of questions. And that brings us to what ICOGR is all about — developing suitable standards and capabilities which will make it possible to access and correlate data from a variety of different but integrated data bases.

CHAIRMAN GROOT: I think that is a very good and concise summing up, John. Thanks. Mike Young?

A: MR. MIKE YOUNG (Topographical Survey, Canada): We have a lot of geographically referenced information, however an important aspect is the correlation of all these data bases. The means to do that on a universal basis in the Province of Ontario will not be here for thirteen years, when the Ontario Base Map Program is completed. I think it would be wrong to assume that we have all sorts of information and we don't have a system to process it; we still must have the base maps to provide the means of correlation.

CHAIRMAN GROOT: Thank you Mike. John Kerr?

MR. JOHN KERR (MNR): What Mike Young said about taking thirteen years to complete OBM coverage of Ontario is true. It is also true the OBM base maps are required before correlation of much of the information we are concerned with can be effected. The fact is, the OBM mapping system was designed as a foundation for geographical referencing in order to facilitate the correlation of data. It together with the Ontario Geographical Referencing Grid form two of the most important components of the comprehensive geographical referencing system Ontario is developing. We recognize the present need for the hardcopy OBM map and have started to produce them. We also recognize some of the advantages and the potential uses of digital maps and we are therefore investigating this technology. If we can find or develop an effective system for producing digital maps that will satisfy the requirements of the thematic users I am sure it would be incorporated in the map making process. Thus in thirteen years instead of having a complete inventory of OBM hardcopy maps we would also have, at little additional cost, a good portion of the planimetry and topography in digital form.

Several delegates at this conference have already indicated they want the OBM maps in digital form so we are not too early. And although much of the data we wish to correlate already exists on different maps, we are not too late. We have to begin somewhere if we are ever to have a comprehensive system. We will continue to develop standards

and research digital technology. We have not yet begun to digitize the OBM maps as part of the production process but no doubt will, when we are satisfied a system is available which can effectively do so.

M. MICHEL PARADIS(Quebec): I would like to say that it is not too late. In a sense, maybe it is a good thing that too many OBM maps are not already produced. Let me tell you about our experience in Quebec. We have a base mapping program like the one you have here in Ontario. Our sheets are twice as large as yours and we have already produced 1,200 of them at 1:20 000 and almost as many urban maps at 1:1000 or 1:2000 in various cities. They are all line maps. My department is moving towards digital mapping. A decision is going to be taken in a week or two — or long after the election — to have one third of our annual production done digitally. But what are we going to do with the existing maps? We have a geographical base but it is not digitized, and back in the beginning of the seventies when we started producing the maps at 1:20 000 we did not have in mind raster technology to digitize them. The digitization of these maps is going to be difficult. One of our preoccupations is to find the best technology to interactively and automatically perform this operation. We are discussing this question with the Federal Government (EMR).

Another similitude Quebec has with Ontario has been discussed this morning: We are both very concerned with our relations with the municipalities. It is relatively easy to discuss with the users of the 1:20 000 (forest inventory people, agriculture, etc.) about georef systems at this scale. But it is another thing to discuss the same thing with 1,600 municipalities of all sizes. A discussion with a city like Montreal is not a problem. This city started digital mapping in the beginning of the seventies and they have expertise. But discussions with the smaller municipalities indicate that they are not ready to go digital.

CHAIRMAN GROOT: Thank you very much, Michel. Robert Code?

MR. ROBERT CODE (MNR): Richard, I accept your invitation to enter the fray. You have raised some thought-provoking questions on such things as the need for and the cost of collecting more information and the rate at which we have been moving to remedy the inadequacies in information files reported by the Committee on Government Productivity. In terms of time it may be fair to say that it has been only over the last twenty years that the problems of information referencing have become recognized. For the last ten years we have been racing along at a great rate to overcome them. The rate is such that I believe much of our time has been spent to keep from stumbling! When I look at the present need or purpose of referencing in Ontario in one sense, I see that we are replacing a (referencing) system that started in 1793. So., we have a 200 year old information referencing system to replace and we are not going to do it overnight. The referencing system to which I refer is the township system in Ontario, one which is very basic as all your titles and political divisions are based on it. When we have a land problem we seem not to be able to do anything without getting a surveyor to run a line geographically on the ground. It could be the line of 1793 that he must retrace. We are locked into a system with titles to identify and something must be done to improve the basic system.

CHAIRMAN GROOT: Thank you, Bob. Yes, Sir?

MR. TERRY FISHER (Department of Tourism and Renewable Resources, Saskatchewan): I think I felt challenged when you were asking for reports from the provinces and then skipped from Alberta to Manitoba. (Laughter)

CHAIRMAN GROOT: I'm glad you did. (Laughter)

MR. TERRY FISHER: I have to say that the effort in Saskatchewan, at least as far as I know, seems to be somewhat more diverse than in Ontario or Alberta. Thus far a couple of agencies have been quite involved in geographic mapping systems. The agencies that I am working for are Forestry Branch and the Department of Urban Affairs.

Forestry Branch is currently using a grid-based system that was developed internally. We are looking at a more sophisticated technology and at this time we are involved in a Pilot Study with Environment Canada. The Department of Urban Affairs is also involved in a Pilot Study with Environment Canada. At this time I do not see any big thrust for a centralized system in Saskatchewan.

The second point I would like to make is a comment on what Jim Linders has said. Certainly I am in agreement with the statement that what we are looking for is not a single system but rather a set of standards. The concept of developing standard specifications so that they can be used by people with a wide range of interests is a tremendous idea. But in practice there are some very serious problems in their development and implementation. I spent a couple of years working on a Standards Committee which consisted of members from Environment Canada, the Canada Centre for Remote Sensing, Statistics Canada and Agriculture Canada. We spent quite a number of hours trying to come up with a standard format for the transfer of geographic data. In spite of our best efforts there have been serious problems implementing this standard. I think the real difficulty lies in the fact that you are not just transferring attribute data, but spatial data which has an implied topological structure. The data format employed must be sophisticated enough to allow all the topological relationships on the map to be encoded.

Q: CHAIRMAN GROOT: Don't go away. Is it not because the essence of the attempt made in Ottawa was in response to a certain need, that this was tried at all? And maybe it is not all that important right now that it may not have been 100% successful. It may be more important to say: "Well, there was a need for this, and this is why we tried it." and I think this need is what we are trying to address here.

A: MR. TERRY FISHER: Yes, I'm sorry, I did not want to leave that impression. Certainly I think you have to start somewhere. You must build a standard, find out what is wrong and correct it. There certainly is a need for mechanisms to facilitate the transfer of data

between agencies. I believe the spatial data transfer format referred to earlier is, in fact, a good compromise for the transfer of spatial data. The format employs a simple chain structure with polygon identifiers right and left. This is a very simple structure that fully defines the topology of a polygon map. The implementation problems have been related more to particular requirements of systems than to the structure itself. For example, some systems require that the map neatline be part of the digital data so that all polygons in the file are closed. Other systems do not have this requirement and hence the data they pass to the standard structure would not have the map boundaries. As another example, some systems do not require precise or mathematical closure of all segments at a node. In a data file created by such a system, there could be numerous gaps in polygon boundaries. This causes most other polygon systems serious difficulty and makes the data unprocessable without a considerable amount of editing. These are but two examples of the problems encountered in implementing the standard format I mentioned earlier.

CHAIRMAN GROOT: Thank you very much for your observations. Jim?

DR. JIM LINDERS: I just couldn't let that one pass. First of all let me say that we clearly all recognize that we have to pass over to others more than just simple primitive data, and that is the problem. We recognize that we have to pass over information technology as well. But why should that be so difficult? Communicating things has gone a long way and we can communicate through abstract structures now. In the past we have just passed simple formatted data and people have learned to live with that. Going back to why we need a data base, the data base in essence imposes *defacto* standards; it tells us how to deal with a certain set of entities. When talking about geographical data bases or land mass data bases, or land relations, etc., we are talking about a set of entities that have meaning in terms of the land mass. They are features, and the way that we deal with these features is probably common across all the applications. The data base tries to achieve within an information

system environment those very things that we do manually now, and that is why the data base is important. This may not be an easy thing to realize but I think it goes a long way towards this goal. The very fact that we can integrate data, as people have stated today, indicates we are in the right direction. If we fail to do this, we will end up with complex structures and won't be able to communicate between structures. Essentially this means removing the structure from the data for communication then rebuilding structure if possible. At least now we have the perspective of seeing what the problems are and if we do not build the solutions into the problems now, it is going to be too late.

CHAIRMAN GROOT: Thank you. If there are no other provinces or municipalities that feel challenged — of course I may have missed them . . . there comes Manitoba.

MR. DAVE CRANDALL (Manitoba): Thank you, Dick. I hesitated to get up and report that there was really very little or no activity in Manitoba at the present time. In January of 1979, an inter-departmental committee recommended to our Provincial Land Use Committee, which is comprised of four or five Ministers, the development of a provincial wide information system. However, there has been no reaction to the report. As a matter of fact, I would suggest that we are probably at the first trough on the hope and despair chart that was shown on the screen. (Laughter)

CHAIRMAN GROOT: Thank you very much. Yes?

MR. MARÇEL MERCIER (Alberta): I am an information systems planning consultant presently working in Alberta. I want to mention other related work going on in that province that is based on a different approach to what has been described here so far.

For the last year and a half I have been carrying out a project for the Alberta Department of Energy and Natural Resources (ENR) to design a comprehensive natural resources information system. The

project is called the Natural Resources Databank Project. The purpose of the Databank is to make public lands and natural resources information available to users in a form they require, together with the tools needed to apply this information to decision making and planning.

First, a bit of background. ENR is the provincial department responsible for the administration and management of all public lands and natural resources in Alberta. This includes fisheries, wildlife, forestry, minerals, coal, oil, gas, and public lands which amount to two-thirds of Alberta's 270,000 square miles.

How ENR's approach to the Databank design differs from other approaches described here today, is that it was recognized early that the Databank was not a comprehensive computer system; but rather that we were dealing with an information management process which had to be redesigned. We started by identifying what resource information was required by users, the characteristics of that information and the form in which it was required. Also, the question of what is meant by resource information had to be answered. It was recognized that resource information is multiform, e.g. maps, air photos, reports, etc., and paper based now, but is required in digital form and will be digitally based in the future. Resource information is very complex and technical and as such requires strong technical services both for collecting it and putting it in a form that is usable by end users. The design process therefore includes a detailed look at the technical services component as well as the end user requirements. In assessing user requirements, the design process included identifying and studying the type and form of resource information needed, and the systems or mechanisms that are presently in place for acquiring information.

The study has recently been completed. One of the follow-up projects that has emanated is to modernize the Department's resource and administrative mapping activities through computer assisted techniques. (The Department is responsible for the majority of the province's resource mapping activities and base mapping. A major ten-year base mapping program was also recently initiated.) The study phase of this computer

mapping follow-up project is to determine the best method for proceeding with the development of a computerized common map information base which will not only support map production but will also support extensive map interpretation and analysis functions. This study will be undertaken in 1981. The common map information base has been identified as a major component in the natural resources databank process. Also identified as a major requirement in the Databank is the coordination and development of standards as already pointed out by Jim Linders. This requirement is not limited to technical and computer standards only. There are procedural standards and standards that are dependent on the form of the information being managed, standards for making information available and so on. Many different aspects are being considered.

Further information on the project can now be made available from ENR.

CHAIRMAN GROOT: Thank you very much. Are there any other questions? You have a question, Ralph? Go ahead.

MR. RALPH SMITH (Metropolitan Toronto): I would like to make several points based on the Metropolitan Toronto and City of Toronto experiences. Metro started the production of its large scale base maps in the 1960s. Once our users switched to a good line mapping system, we found them reluctant to go the next step and switch to a digital mapping system. Ontario may find itself in the same position unless it switches to digital mapping soon.

As indicated, one of your key concerns is the availability of money for new programs. One of the reasons we had trouble starting our base mapping program, in the 1960s, was that too much money was available. Everybody did their own thing; they could afford to individually draw maps for each project. As money became scarce, they started to say: "Let's share the costs of common mapping." Now they are starting to say: "Let's share in the costs of a common data base that allows us to share data." The best time to share is when money is tight. The users are not admitting that there is something technically wrong with the old programs; rather it is time

to create an integrated system and reduce individual project costs.

As Mr. Datlen pointed out, the City of Toronto did not wait for large scale base maps but used the available maps to geocode its records. Similarly the Province of Ontario may not need to wait for the OBM maps to geocode some of its records. The Province may be able to use existing maps or triangulated aerial photographs. The key identifiers may be geocoded directly from the photographs. As Mr. Datlen indicated, the maps themselves can later serve as background data to these geocoded points. This satisfied the City of Toronto's need for geocoded administration and planning data and may satisfy provincial needs. The urban areas have another level of information that must be coordinated — engineering data. Cities design, build and maintain physical structures that are very close together and often buried. For this application a city needs very large scale maps. The maps in Metro are at 1:500 and 1:1000 and there are thousands of them. In addition, there are hundreds of thousands of derived individual contract and project plans and drawings. There is a limited number of basic features shown on these maps and municipalities need to share this engineering level data. Certain administrative and planning records can be geocoded without the detailed base maps but for other records the maps are required. Care should be taken to not separate these two levels of data when implementing an integrated system.

CHAIRMAN GROOT: Thank you very much. Ladies and gentlemen, there is a note here which says there are copies of a list of the conference delegates in the lobby. I suggest you pick up a copy. I would like to thank this morning's speakers and the audience for your participation in the discussion. We will see you back here at one o'clock.

AFTERNOON SESSION — WEDNESDAY, MARCH 11th, 1981

CHAIRMAN GROOT: Welcome to this session of the Seminar on Geographical Referencing. This afternoon we will hear three presentations before the coffee break at 2:30. An open forum will follow. I would like to invite you to ask questions after each paper if you have any. If, however, you have something really controversial to say, perhaps

you will save it until the Open Forum, when all the speakers will be assembled up here to respond to you.

The next speaker is Zulfikar Gulamhusein, who is the Head of Mathematical Adjustments, in the Geographical Referencing Section in the Ministry of Natural Resources. Zul was a member of the team which designed and developed the horizontal control survey adjustment program, MANOR; he is currently involved in the development, and responsible for the administration, of Ontario's horizontal control survey data bank COSINE. His presentation is about horizontal control surveys and the Provincial Horizontal Control Survey Data Bank. Zul, would you please come up? (Applause)

MR. ZUL GULAMHUSEIN: Thank you, Dick.

CONTROL SURVEYS AND THE PROVINCIAL HORIZONTAL CONTROL SURVEY DATA BANK

MR. ZULFIKAR GULAMHUSEIN
MATHEMATICAL ADJUSTMENTS, MINISTRY OF NATURAL RESOURCES

Good afternoon ladies and gentlemen. So far in this Seminar we have heard a lot about the systems of the future, but I am going to deviate slightly from this trend and talk about the present-day system, a system that is almost ready and will be implemented shortly. It gives me great pleasure to have this opportunity to talk to you this afternoon about horizontal control surveys and the provincial horizontal control survey data bank.

Over the last day and a half we have heard a lot about the geographical referencing grid. Control surveys form the foundation for such a grid. Geographically referenced data seems to have developed an inseparable bond with computers and computer graphics. To enable us to store geographically referenced data in a computer system, each piece of data has to be transformed into numerical values defining, among other things, the position of that piece of data on the surface of the earth. In order to correlate the various pieces of data collected by various agencies, all numerical values defining position have to be referenced to a common origin or datum. Control Surveys, ladies and gentlemen, provide this datum in the form of a geographical referencing grid.

For those of you who have been wondering what relationship control surveys have with geographical referencing, I hope to be able to convince you this afternoon that if there were no control surveys then there would not be a UTM geographical referencing grid and perhaps we wouldn't have had this seminar.

I have been led to understand that a majority of the audience here today may have only a slight acquaintance with control surveys and for the benefit of that sector of the audience I will briefly go through the basics of control surveys.

Control surveys are divided into two broad categories, namely horizontal control surveys and vertical control surveys. As the names suggest, horizontal control surveys define positions in the horizontal plane and vertical control surveys define positions in the vertical plane. To-day's talk deals with horizontal control surveys only. Figure 1 lists the commonly used terms in control surveys.

It all begins by establishing a series of points on the surface of the earth. These points are marked in a variety of ways, one of which is the cementing of this (Figure 2) brass plug on a rock or concrete surface. These markers are referred to as control survey monuments or stations. Each of these monuments is assigned a unique monument number. I am sure a lot of you have seen these brass plugs on sidewalks along Metro streets. You may have stepped on one of these monuments not realizing that you are stepping over an information bomb. A collection of these monuments established during a given project is referred to as a control survey network (Figure 3). The next task is to determine, very precisely, the position of the centre of each of these monuments with respect to a pre-defined origin, i.e. to determine the latitude and longitude (coordinates) of each monument.

To do this a set of relations has to be established amongst the new monuments and between the new monuments and other existing monuments in the area. These relations take the form of distances, angles, directions and azimuths. They are referred to as measurements or observations (Figure 4).

The relative accuracies required for these measurements will depend on the order of the control survey network being established. Control survey networks are grouped into first, second, third and fourth orders. The lower the order number of the network, the higher the standards of relative accuracy of the measurements used to establish it.

In Ontario the responsibility of the first order network lies with the federal government. The province and municipalities assume responsibility for the lower order networks.

SOME OF THE COMMONLY USED TERMS IN CONTROL SURVEYS.

MONUMENTS (STATIONS)

NETWORK

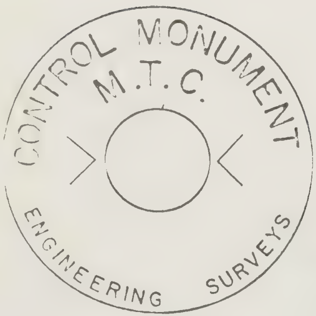
MEASUREMENTS (OBSERVATION)

ORDER

ADJUSTMENT

Fig. 1

MARKER ILLUSTRATIONS



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HISTORIC NAME: 753001
STATION NUMBER: 008753001

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HISTORIC NAME: CT-474
STATION NUMBER: 0022740474

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HISTORIC NAME: 750001
STATION NUMBER: 02075001

Fig. 2

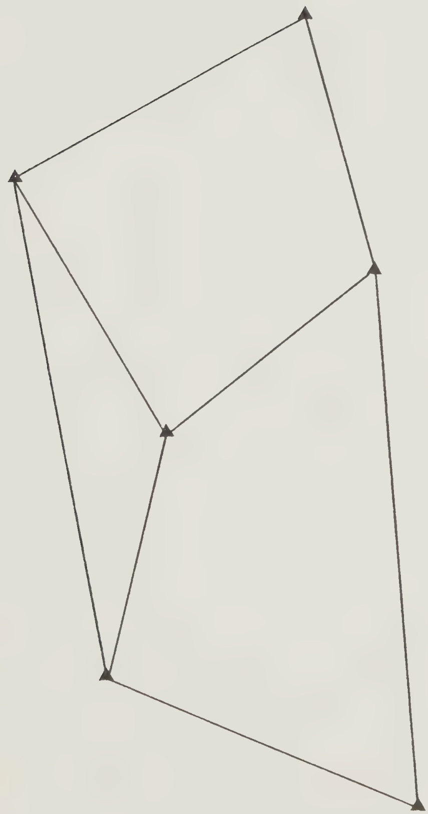


Fig. 3

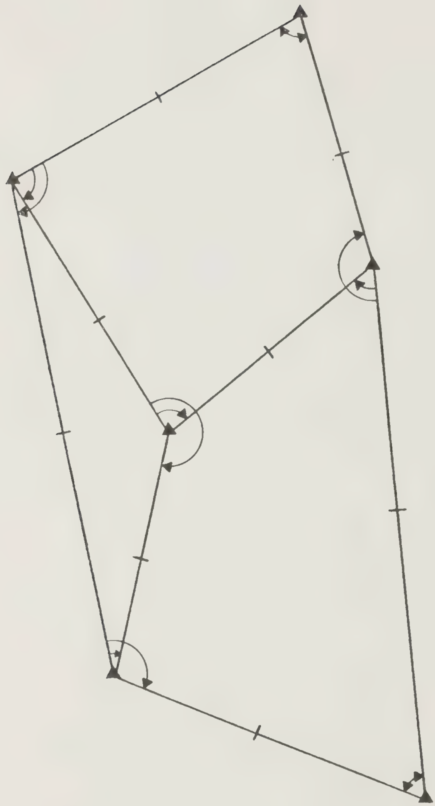


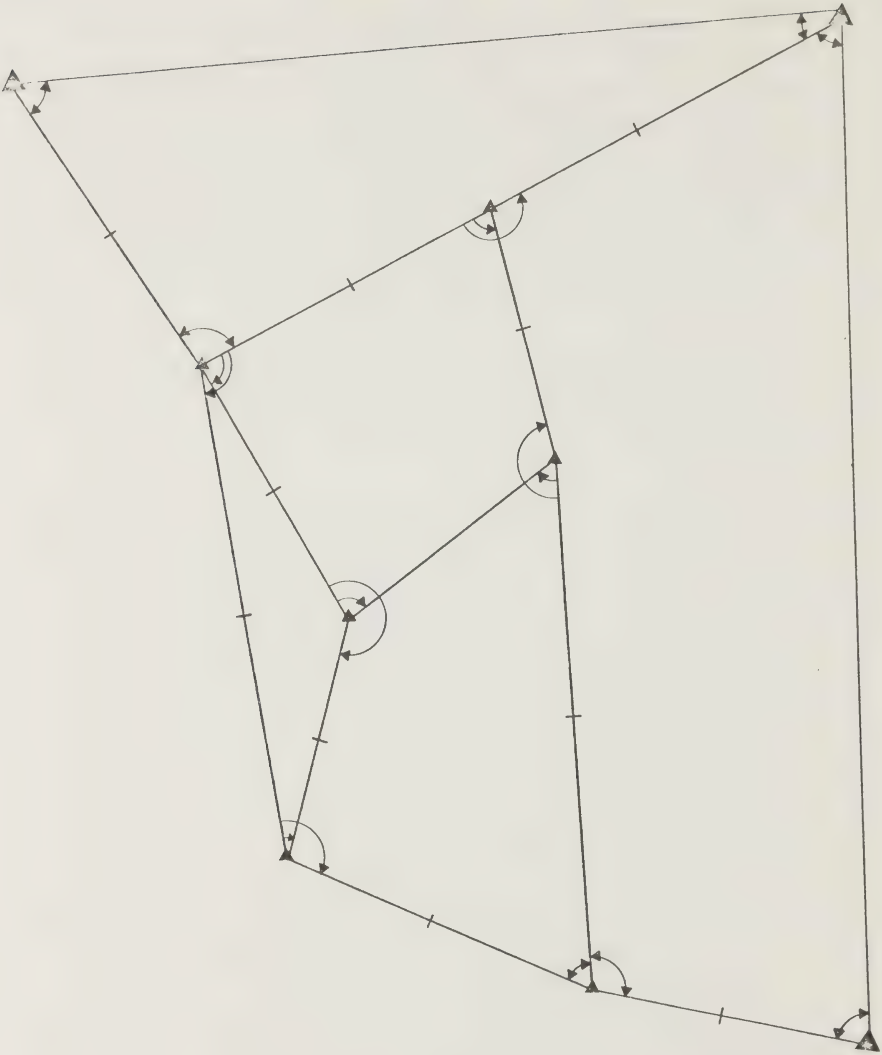
Fig. 4

To obtain coordinates for monuments of a network being established it must be connected to a higher order network existing in the area (Figure 5). The coordinates of the monuments of the higher order network, the new measurements and their respective accuracy estimates are then used to perform a rigorous mathematical process called adjustment, which determines the coordinates of the new monuments. To perform this sophisticated mathematical process, the Ministry of Natural Resources has developed a computer program called MANOR (Multi-purpose Analysis of Network Observations and Reductions).

I hope that by now we all have a general idea of what control surveys are and how they are established. Now let us look briefly at the use of control surveys for mapping and for establishing a geographical referencing grid.

Quite often you notice bright crosses painted on sidewalks with a brass cap (monument) at the centre of each cross (Figure 6). These paint marks are not there to make monuments more appealing to the public. These marks, known as targets, are established prior to taking aerial photography of the area intended to be mapped. They enable the mappers to have coordinated points on photographs by identifying these targets on them. We will skip the technical details of map production, however when a map is produced the positions of control survey monuments, identified on aerial photographs, are accurately plotted on the map (Figure 7). Geographical referencing calls for digitizing data from these maps. The data digitized has to be related positionally to a common grid. The position of the digitized data will depend on the position of the grid on the map (Figure 8). These control survey points, or other points related to these control survey points, determine the position of the grid on each map. Without control surveys our UTM geographical referencing grid becomes only a mathematical concept and there is no way of positioning this grid on our OBM maps.

I hope I have been able to bring to light the necessity for control surveys and how these surveys are an integral part of the geographical referencing system.



▲ 1st ORDER

▴ 2nd ORDER

Fig. 5

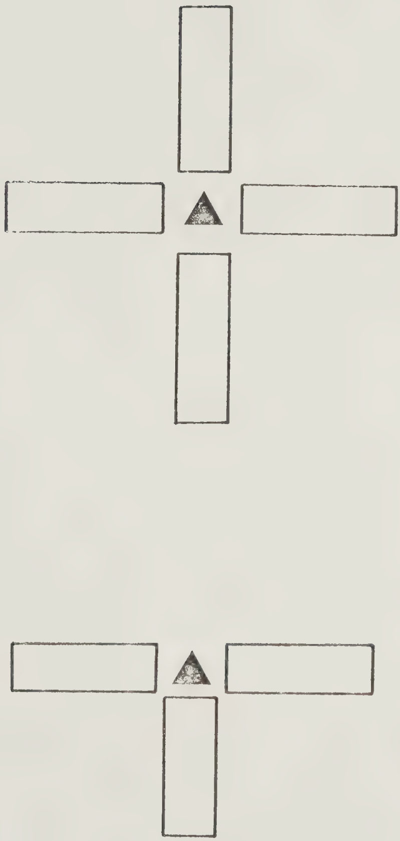


Fig.6


228
AYLMER
CONTROL
STATION
Bradleys
Creek
224.0
226.5
225.0
225.5
227.0
226.0
225.5
226.5
225
225.5
227.0
225.5
CONTROL
STATION
225.5
227.5
225.5
230
225
226.5

Fig. 7

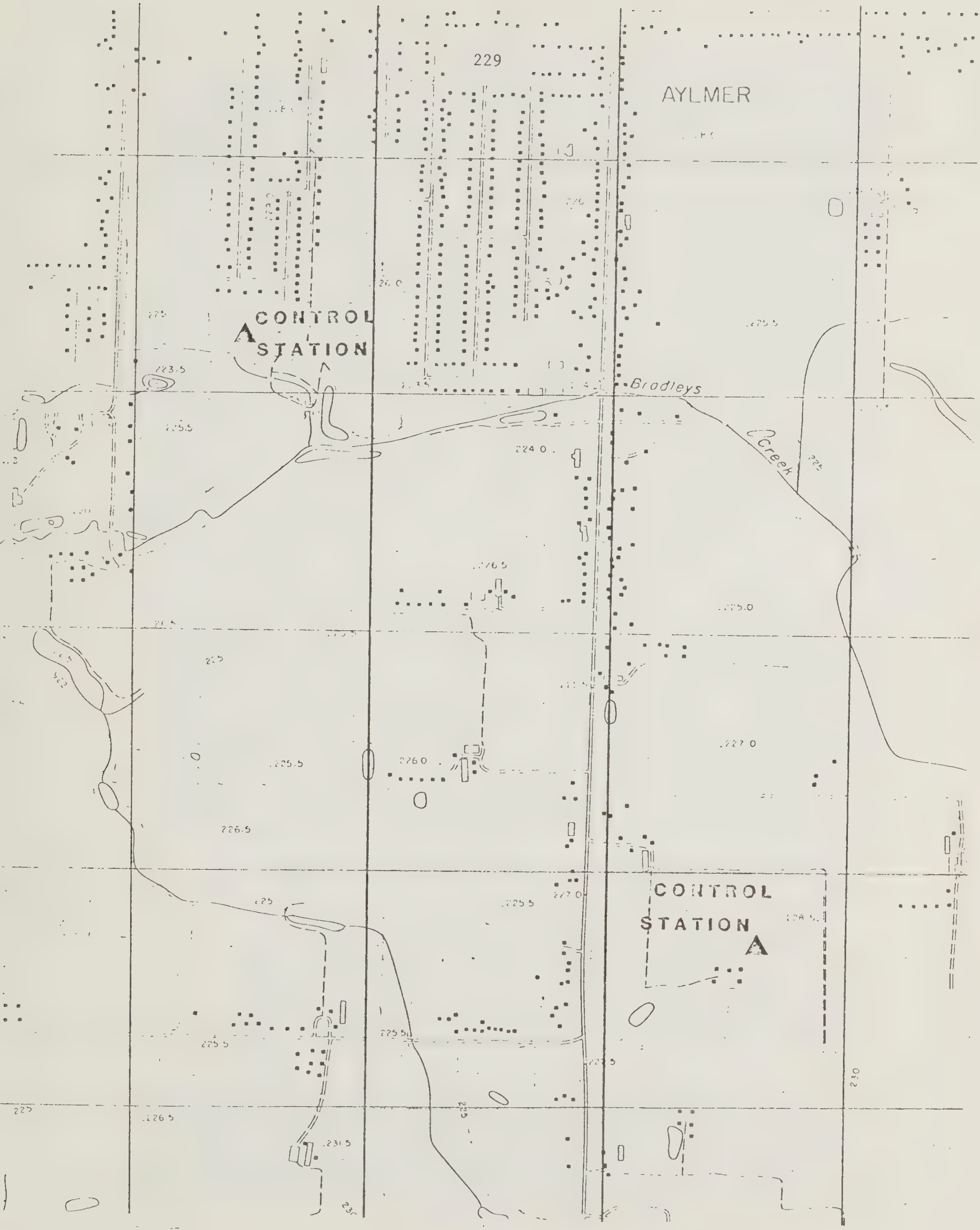

229
AYLMER
CONTROL STATION
Bradleys
Creek
CONTROL STATION

Fig. 8

The uses of control surveys are plenty and the demand for access to control survey information is high and continually increasing. Unfortunately, at the present moment, we do not have a single organization that monitors all establishment of control surveys in Ontario, nor do we have a centralized depository for control survey information. Control surveys in Ontario are established by a variety of private and public agencies and lack of communication between the various agencies makes access to control survey information a frustrating experience. It is up to the users of control survey data to determine, firstly, which agencies may have established control surveys in an area and then obtain data from these agencies and determine if data from the various agencies is compatible, etc. This problem of access to control survey information led to the need for centralizing all control survey information in Ontario. There are approximately 60,000 control survey stations in Ontario and the data associated with these stations is voluminous and continually increasing. Control survey networks are dynamic. They have to be maintained by replacing destroyed monuments, making new measurements to replace old ones, or duplicating old measurements. The networks have to be extended as the need arises. For efficient handling of this massive amount of data the Ministry of Natural Resources designed and is developing a computerized databank. This databank is given the acronym COSINE (Coordinate Survey Information Exchange). The objectives of COSINE are:

- to centralize control survey information within the Province;
- to provide a computerized filing system for agencies installing and maintaining control survey networks;
- to provide an efficient system for storing, retrieving and handling control survey information, and
- to facilitate future re-adjustments of existing control survey networks.

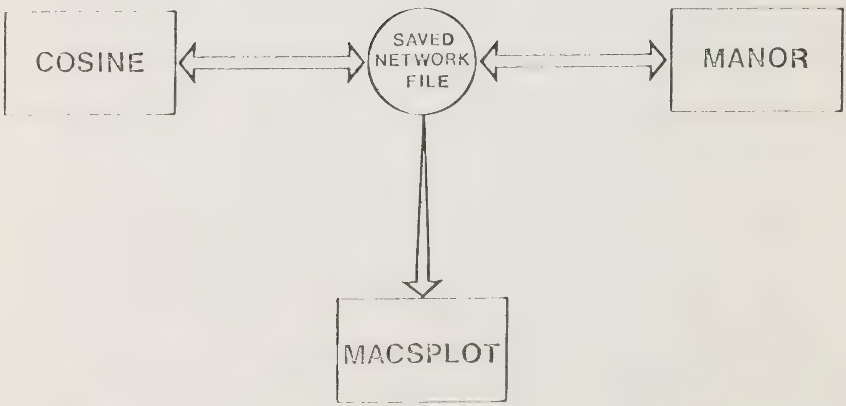
From time to time, re-adjustments of control survey networks are performed and new coordinates for existing monuments are obtained. Re-adjustments become necessary due to detection of errors in previous adjustments or due to changes in technology that yield more accurate

results or due to changes in the definition (parameters) of the datum or spheroid which is the mathematical model upon which all calculations are based. Re-adjustment may be restricted to a small area or it may be province-wide depending on the cause of the re-adjustment. The federal government, in cooperation with the governments of the United States of America, Mexico and certain other countries has decided to redefine the North American datum some time in 1984. This will necessitate the re-adjustment of all Canadian networks. COSINE will play an important role in the re-adjustment of Ontario networks. COSINE is designed to be totally compatible with the adjustment program MANOR and the automatic plotting program MACSPLOT (Figure 9). Data can be channeled from COSINE to MANOR for re-adjustment and the new re-adjusted data can be channeled back from MANOR to COSINE for storage. Data flowing between COSINE and MANOR can be viewed pictorially by plotting it using MACSPLOT. (Figures 10A, 10B have been plotted using MACSPLOT.)

Figure 11 shows the flow of information in the COSINE system. It has two principal components, the data base and the user interface program. The user interface program performs extensive editing of the data before storing it in the database. Extensive editing of data is an absolute necessity for a province like ours where data resides with various agencies and data borrowed by one agency from another over a number of years, and subsequently supplied to the Ministry for storage in COSINE, may result in duplication and inconsistencies. Loading of data into COSINE will be under the control of the Ministry of Natural Resources.

Agencies possessing control survey data should verify their data, prepare it in a format suitable for loading into COSINE and submit it to the Ministry for loading. The various types of data required to be stored in COSINE are shown on Figure 12. For the databank to be successful, all data in the Province has to be stored in COSINE. Cooperation and participation of all control survey agencies in the Province is required to achieve successful implementation of COSINE. To date the Ministry has been working closely with a number of agencies such as

Fig. 9
COMMUNICATION BETWEEN COSINE, MANOR & MACSPLOT



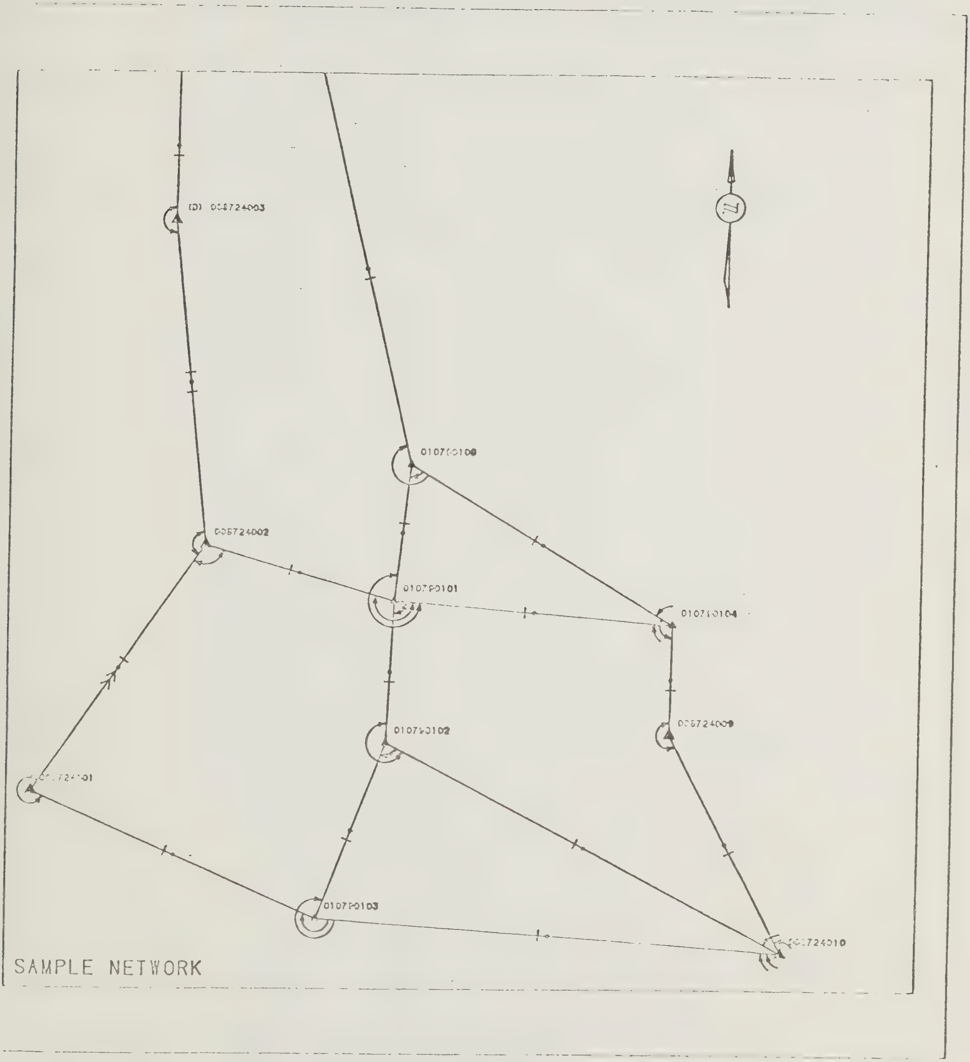


Fig. 10A

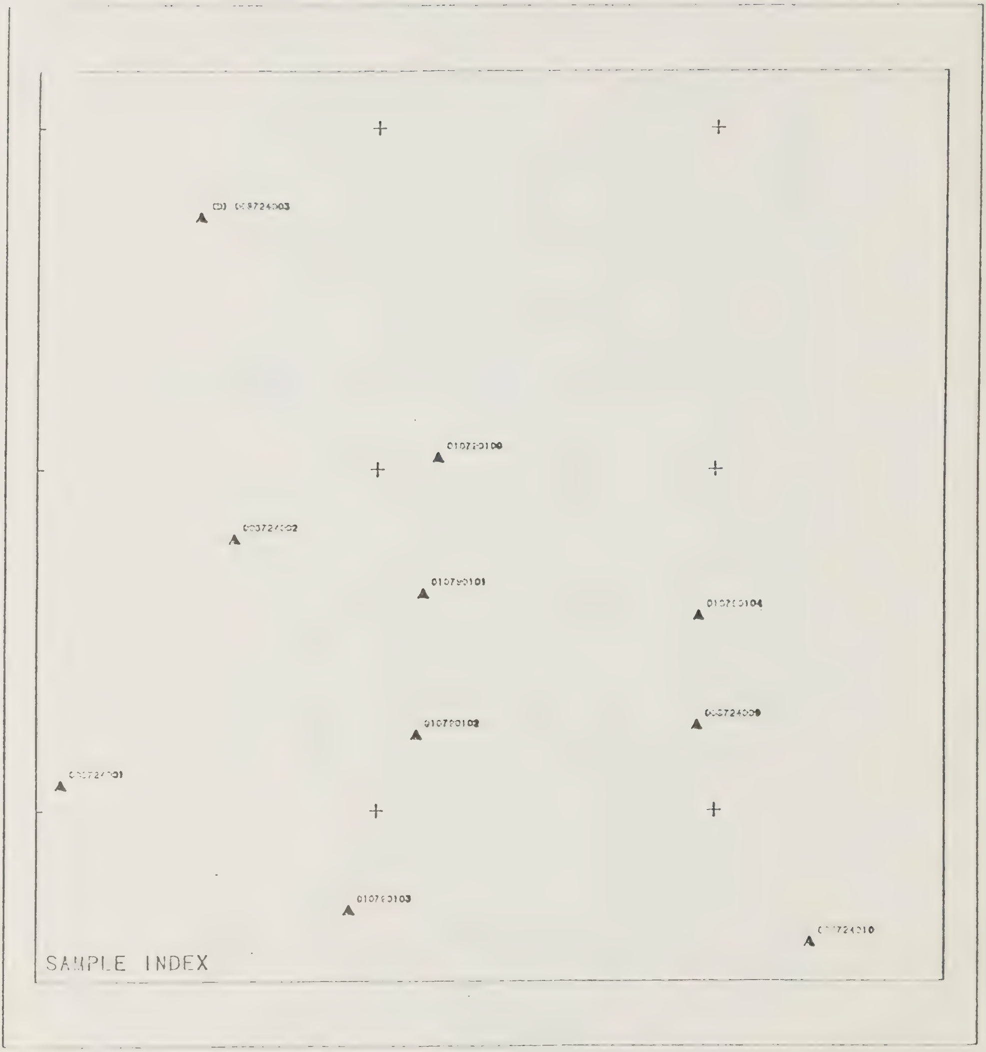


Fig. 10B

Fig. 11
COSINE SYSTEM
FLOW OF INFORMATION

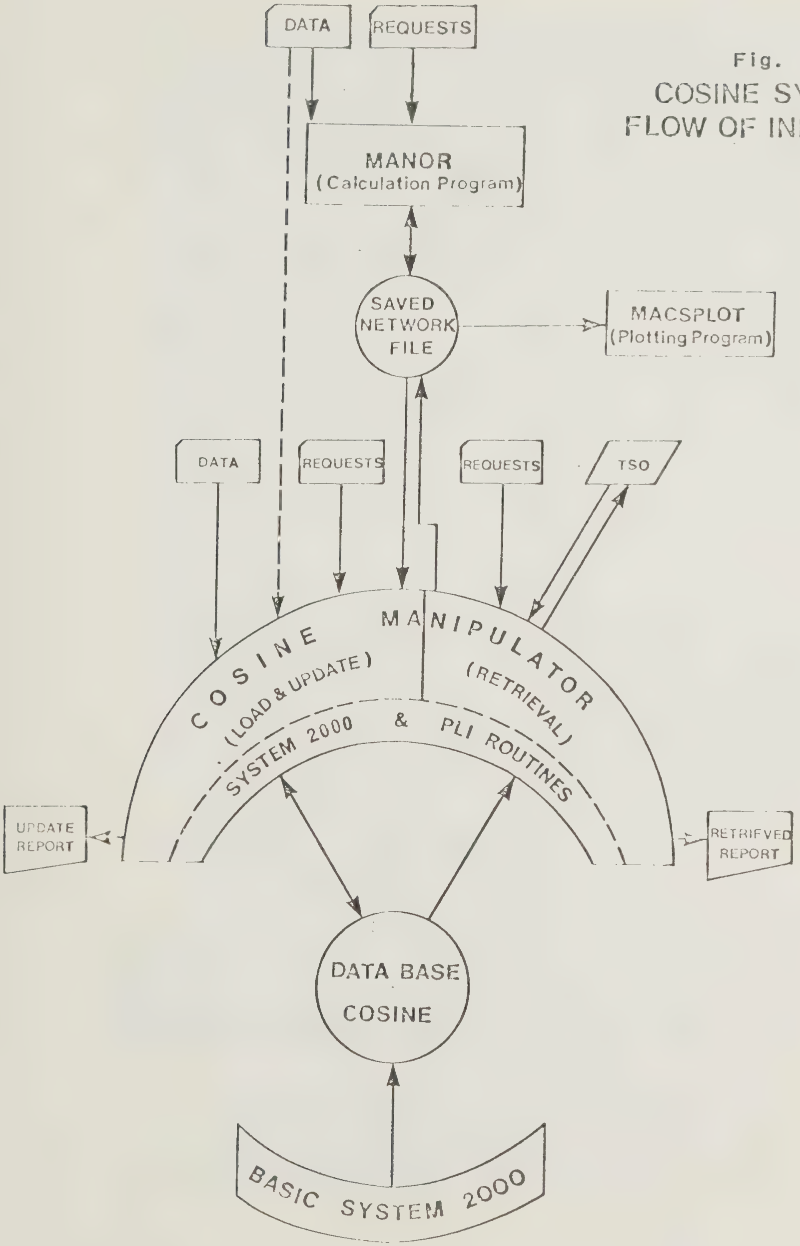
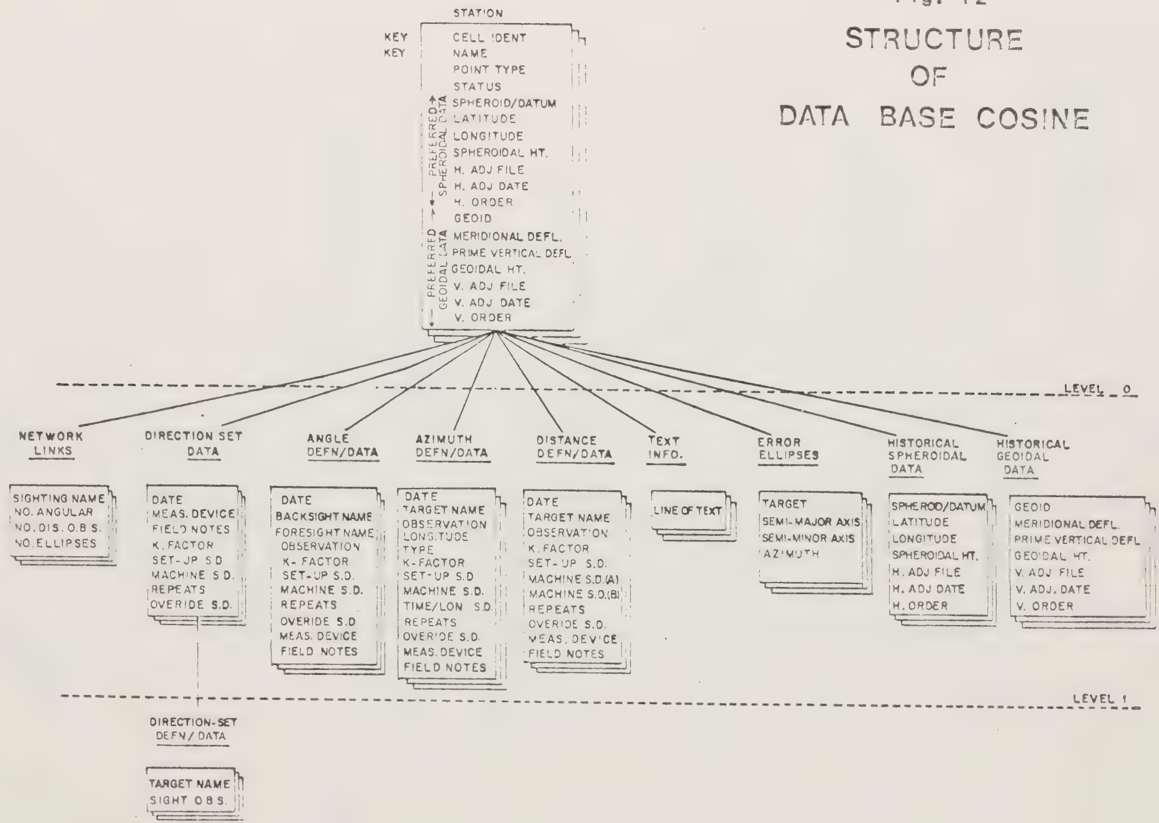


Fig. 12

STRUCTURE OF DATA BASE COSINE



Geodetic Survey of Canada, Ministry of Transportation and Communications, Municipality of Metropolitan Toronto, National Capital Commission, the regional municipalities of Waterloo, Hamilton-Wentworth and Sudbury, the cities of St. Catharines, Windsor and many others. Data from these agencies has either been supplied to the Ministry or is in the process of being supplied. Representatives of agencies who have control survey data and who have not been contacted to date are requested to get in touch with the Ministry.

COSINE is a batch-oriented system. However, on-line retrievals will be possible using IBM's Time Sharing Option (TSO). TSO combined with data communication systems such as DATAPAC will enable users, anywhere in the Province, to retrieve data from COSINE. Retrieval of data will be under the control of a password that will be issued by the Ministry to users upon request. Data retrieval can be performed by station number or by geographical area. A geographical area can be defined by a polygon or a circle.

Time does not permit me to go into the technical details of COSINE, but the Ministry will be pleased to answer any questions you may have pertaining to COSINE, MANOR or MACSPLOT. Thank you.

There is one fact I forgot to mention and that is, COSINE is being developed under contract to the firm of J. D. Barnes, Limited. They have done an excellent job so far. This is the same firm that developed the MANOR program for the Ministry.

CHAIRMAN GROOT: Thank you very much, Zul. Are there any questions? I think you have done such a fine job of explaining this complex problem of control surveys to outsiders that they probably understand it and they won't use survey monuments for other purposes any more. (Laughter) Thank you very much for a fine job. (Applause)

We now go to another topic in this area of geographical referencing, one that involves a problem we are all faced with from time to time — the definition and registration of our properties. The subject is the

Land Registration Improvement Project. The author is Ray Scott, and he is the lone forester in this session of speakers. He graduated in 1957 from the University of Toronto as a forester. He also became an Ontario Land Surveyor — that is an interesting combination. He worked in the private sector in land surveying before beginning his career in the Provincial Government where he was involved with the examination of survey plans in the Ministry of Consumer and Commercial Relations. In 1976 he started to work on the project that I have always known as the POLARIS Project. However, I understand there has been some change in name and now is a good time to get an update, so please, Ray, come and give your talk. (Applause)

MR. RAY SCOTT: I notice there are a lot of oranges suddenly appearing on the front table this afternoon. I just want to let you know I've got one to throw back. (Laughter)

Yesterday you heard from the dynamic duo of John Kerr and Jim Linders. I am sorry I have to inform you that they are imposters (laughter) and in order to prove that, I will introduce my associate here, he's my chauffeur, and we are a team, known as Map Man and Robin. (Laughter) Being both a forester and a surveyor I can't possible handle modern-day technology and that is why he is here to run the overhead projector. He will also answer questions from the floor. (Laughter) I have struggled very hard with this paper to not go over half an hour, but Richard has informed me again to cut it down to less than half an hour, so there can be questions. So if, towards the end, I begin to talk very fast, it's not that I have suddenly decided I have to go to the washroom — it is that I am trying to keep within the time slot.

THE LAND REGISTRATION IMPROVEMENT PROJECT

MR. RAY SCOTT
MANAGER OF SURVEYS, LRIP
MINISTRY OF CONSUMER AND COMMERICAL RELATIONS

The Land Registration Improvement Project has previously, and to some extent still is, known by the name of POLARIS. POLARIS is an acronym which stands for Province of Ontario Land Registration Information System. For those of you who are not familiar with this project I will give a brief overview of our goals and then provide an update on the progress achieved so far.

In 1971 the Ontario Law Reform Commission, in its reports on land registration, clearly pointed up the need for reform of the existing arrangements for land registration in Ontario.

The Ministry of Consumer and Commercial Relations created the Land Registration Management Committee in September, 1972 to develop a position regarding the Law Reform Commission recommendations.

In 1978, a comprehensive report titled "An Improved Land Registration System for Ontario: Design Concepts and Recommendations" was completed by the Land Registration Management Committee.

The basic recommendations of that report are:

- the Province shall retain responsibility for land registration;
- both the registry and land titles systems shall be retained, at least in the short term;
- both systems shall be improved to the extent possible;
- a single system for land registration shall be used if, after improvement to both, one system proves clearly superior; and
- five improvement "packages" shall be implemented.

The five improvement packages just referred to are:

- LEGAL SYSTEM IMPROVEMENTS,
  to reduce the legal and practical complexity of dealing with the system;
- MICROFILM DOCUMENT AND PLANS SYSTEMS,
  to improve records maintenance;
- CERTIFICATION IN THE REGISTRY SYSTEM,
  to improve record-keeping for land parcels in that system;
- COMPUTERIZED INDEXES, PROPERTY MAPS AND ACTIVITY REPORTS,
  to produce more convenient access to information and to reduce the dependency on manual methods; and
- SELECTIVE AND AGGREGATE INFORMATION REPORTS,
  to provide more useful information from the system.

Computerized indexes, property maps and activity reports introduce automation to the operational area of land registration. This package will include:

- generation and maintenance of property maps using computers;
- unique parcel identifiers for all properties;
- use of an intelligent cash register to capture registration information as it is presented at the local offices and the ability to subsearch using a number pad;
- using computers to generate basic statistical reports for head office;
- using computers to capture information for the abstract indexes and parcel registers; and
- producing pages for indexes and registers using computer printers.

The concepts report was submitted to senior levels of government and in July 1979 Cabinet gave approval in principle to the concept of achieving modern reform through improvements to the existing dual system of Land Registration. Approval and funding were provided which enabled the Ministry to proceed with the detailed design work necessary for the development and testing of the proposed improvements.

Approval of a proposed organization for the project was given in December 1979. The organizational structure consists of a Project Director, four managers, one each for the areas of surveys, legal, systems and operations with a number of analysts, technical and support staff working with each manager. Mr. Norman K. Harris was appointed to the position of Project Director in July of 1980. All of the managers and most of the analysts, technical and support staff have been hired and are now working on the project.

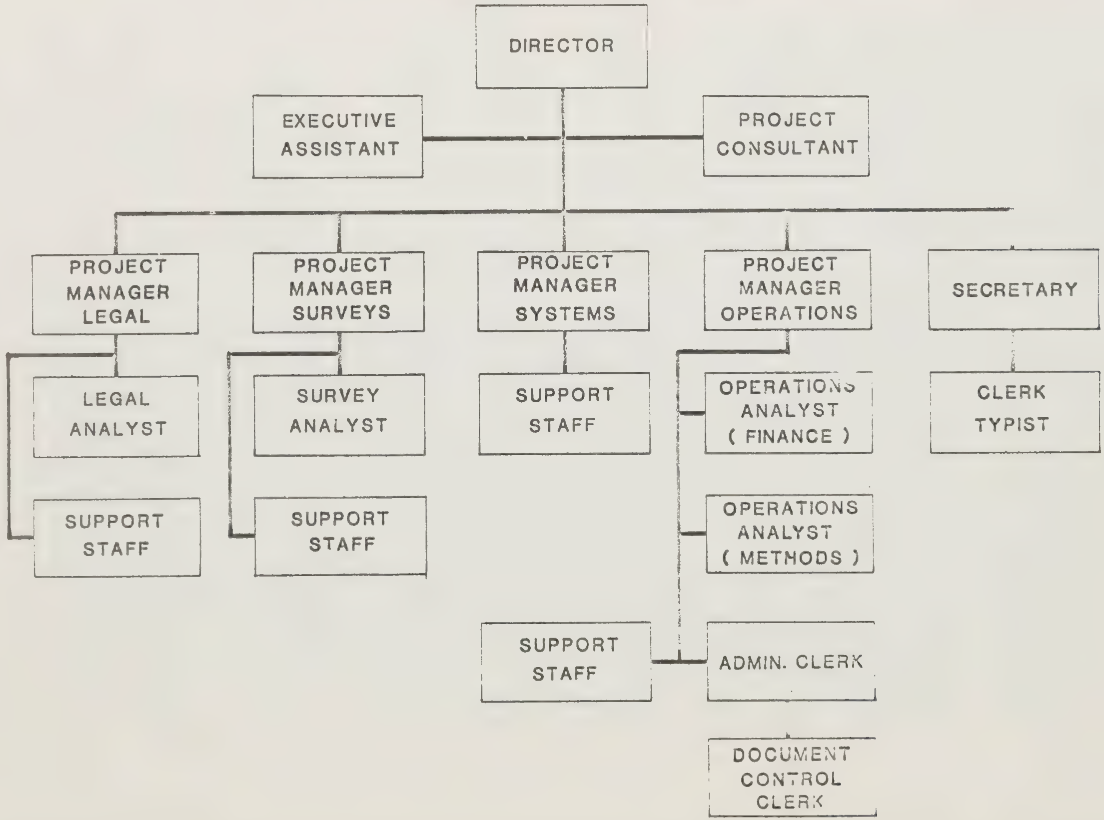
The planning for the initial phases of the project is complete. Preliminary studies which define, for each package, the scope, problems and possible solutions to those problems have begun.

In the area of the legal improvements it is expected that legislation will be ready for introduction in the Legislature by April 1, 1981 to shorten title searches by reducing the search period in the Registry system to twenty-five years and to make all discharge of mortgages immediately effective.

A detailed plan for Phase I of the property mapping project is complete. This plan covers an elapsed time of 70 weeks, identifies 16 major activities and 129 separate tasks within these activities.

One of the first activities that was undertaken for the property mapping project was an investigation of existing Federal and Provincial standards and policy in the area of mapping. This study was undertaken to determine the framework within which the property mapping project team would work when undertaking initial design studies. This study has shown that:

LAND REGISTRATION IMPROVEMENT PROJECT
ORGANIZATION CHART



1. Cabinet Minute 7-34/77 dated July 26th, 1977, set standards for the Ontario Base Maps in terms of:
   (a) grid and projection;
   (b) map scales;
   (c) map format; and
   (d) indexing.

2. Regulation 809 under The Surveys Act defines and sets out parameters for the Ontario Co-ordinate System which is the Transverse Mercator projection modified to a 3^{o} zone of the Clarke Spheroid of 1866.

3. The Interministerial Committee on Geographical Referencing in its report to Management Board in 1978 recommended the use of the Universal Transverse Mercator 6^{o} projection for ALL provincial mapping along with the development of standard grid cells. The reply from Management Board gave the Ministry of Natural Resources authority to set such standards.

4. The Federal Government Committee on National Standards for Digital Mapping is currently involved in the process of defining standards for:
   (a) feature classification;
   (b) topographic data precision, quality and resolution; and
   (c) electronic data processing standards for digital topographic data.

   It is not known at this time whether these standards would be mandatory or only serve as guidelines.

5. The Federal committee which is known as a Spatial Data Transfer Committee, is developing standard formats for geographic data during its transfer between systems. This committee has published one report titled "Standard Format For The Transfer of Geocoded Data".

6. The 1971 Ontario Law Reform Commission Report previously referred to contained the following recommendations:

- a coordinate control system should be established;
- the property indexing should be based on the coordinates. This index should be designed in cooperation with other prospective users; and
- the index numbers should be recorded on, or perhaps derived from, index maps that include the location of the boundaries of properties.

7. The Survey Task Force of the Ministry of Consumer and Commercial Relations completed, in 1972, a study of the Map Base Resource Inventory in Ontario. This study resulted in a number of recommendations which were submitted to, and accepted by Management Board. There are three recommendations which are of particular interest:

    (1) Consideration should be given to using a property map to which project details could be added. The requirements of project-oriented mapping should be considered in developing the mapping specifications for the land registration indexing and display system.

    (2) The benefits and costs of integrating or coordinating the property-related mapping programs, or proposed programs, of the Ministries of Revenue, Natural Resources, Consumer and Commercial Relations and the Ministry of Treasury, Economics and Intergovernmental Affairs should be analyzed before any new property mapping program is initiated by a Provincial Government Agency.

    (3) The regional municipalities should be included in planning for any new province-wide property mapping program.

    In other words, there was a realization that any province-wide property mapping would have a potential usefulness far beyond the confines of the Land Registration System.

8. The Concepts Report which received Cabinet approval in 1979 contained two recommendations which are important when the area of mapping is considered. These recommendations are:

    (1) Computers should be used to generate dynamic property maps showing all properties in the Province and relating them to the ground; and

(2) Automation should be flexible enough to complement the land information needs of others.

This provides a brief summary of the existing policy and guidelines which must be considered by the project team involved in the detailed design of property maps. What is missing from the above, which establish the policy and guidelines which exist, is a clear provincial mandate which takes into consideration all levels of government (including the private sector) to develop the standards and administration of the standards of land based information systems. The Land Registration Improvement Project cannot develop digital property maps in isolation. We must consider the mapping and information needs of other provincial ministries, municipalities and agencies.

Property Maps - What Are They and How Will They Be Built?

The Concepts Report states that a property map must have the following general characteristics:

- all registered properties are shown;
- the properties shown exist on the ground;
- the relative location of a property to its neighbours is correct;
- a property illustrated on a map (to scale) has approximately the size and configuration of the property existing on the ground; and
- properties are related to the ground in some manner.

The process of building the initial property maps can be divided into two components. The first component consists of the collection of the data which exists in the 65 land registration offices in the Province. This data is contained in plans of survey and registered documents and provides information about property boundaries, property ownerships and values and the encumbrances which are relevant to those properties.

The boundary information does not normally give the geographic position of a property, that is, it does not define the boundaries in terms of longitude and latitude, or plane coordinates derived from a specific

map projection and grid such as the Universal Transverse Mercator projection and grid. Instead, the property boundaries are defined in terms of their position within a township lot, or in relation to another registered plan.

The township fabric which was superimposed on much of the ground surface which forms the Province of Ontario is composed of a series of more or less regular grids and some of the intersection points of those grids were marked on the ground by survey monuments. These grids, however, are inadequate as a control network since they suffer from some severe deficiencies:

1. The geographic position of the grid intersections was not determined.
2. The dimensions of the grids laid out on the ground rarely fit the intended dimensions and no accurate record of the differences exists unless a resurvey has been completed.
3. The original monumentation has disappeared in many instances.
4. The orientation of the various township systems differ.
5. The Province is not completely covered.

Combined with these problems are those imposed by the fact that the plans and documents which exist in the land registration offices can, and often do, contain information which is wrong or not clear. In addition, information may be missing from the land registration system.

The result of all of these problems is that an individual will experience considerable difficulty when an attempt is made to plot, on a piece of paper, all the properties which exist in a given area. Quite often the boundaries of properties will not fit together properly.

The completion of the first component, then, involves collecting the data from the land registration offices, dealing in some manner with the errors and inconsistencies contained within that data, and producing a property map which shows the properties, to scale, as they exist on the ground. This goal must be realized without resurveying all of the properties in the Province.

The problems which exist with the data that will be gathered cannot be solved by applying just a mathematical adjustment. The solutions applied must take into consideration the law that applies to land boundaries, surveying and land ownership.

The second component in the map building process involves the determination of the relationship between property boundaries and the ground. Where do these properties exist on the earth's surface? This relationship is determined by calculating the geographical position of boundary corners. As previously mentioned, this geographical position is expressed in terms of latitude and longitude or plane coordinates.

It is envisioned that this ground relationship will be determined from various sources such as:

1. Ontario Base Maps (OBM) which show both UTM coordinates and the township fabric. It should be noted here that the creation of Ontario Base Maps in a digital format would, presumably, relieve the Ministry of Consumer and Commercial Relations of the necessity of digitizing the township fabric and relevant topographic features from hard copy OBM maps.

2. Derivation of UTM coordinates for the intersections of transportation networks through the use of the Ministry of Transportation and Communications' transportation network geocode. This involves using high level photography, stereoplotters and computers in order to obtain coordinates of the desired points.

3. Existing maps, plans and surveys which show coordinates established through ground survey for township lot corners or property corners.

It is readily apparent when examining the sources of the information that will provide the ground relationship required for the man-made property layer (that is, a layer of information about land that is comprised of theoretical lines that form property boundaries on the earth's surface) that the precision of this information will vary.

Ground surveys which relate township lot corners and property corners to geodetic control stations will provide precise coordinate values for those corners. Coordinate values obtained from the other sources mentioned will vary in precision with the circle of error being perhaps as much as thirty feet in some cases.

The completion of the second component in the property mapping process, then, requires that the best possible ground definition of the township lot fabric be obtained and the property boundaries be fitted into this framework.

The solving of the problems inherent in this process will be difficult. Since we are lacking the precise coordinate values for the township lot fabric which would provide a rigid reliable framework within which we could fit the existing properties, and considering the fact that the land registration system will often provide accurate geometric definitions of properties or even township lots (which we would prefer not to change), the situation becomes somewhat fluid. If the accurate registry office definition of properties and township lots is retained, the ground definition of the township fabric (that is, the coordinate values of the township lot corners) will change. The alteration of the coordinate values for one township lot will change the coordinate values for the other township lots on all four sides of the first — there will be a ripple effect.

Conversely, retaining the coordinate values obtained for the township lot fabric will cause changes to occur in the registry office definition of properties. The accurate geometric registry office definitions will be distorted to make them fit into a township lot framework which in turn may not be precise.

Although I have described the above process as two separate components they may, in fact, occur simultaneously. The difficulty of the problems which must be solved can be alleviated to some degree by making full use of all existing mapping prepared by government ministries, municipalities and other agencies. The Ministry of Consumer and Commercial Relations would especially benefit from mapping programs which result

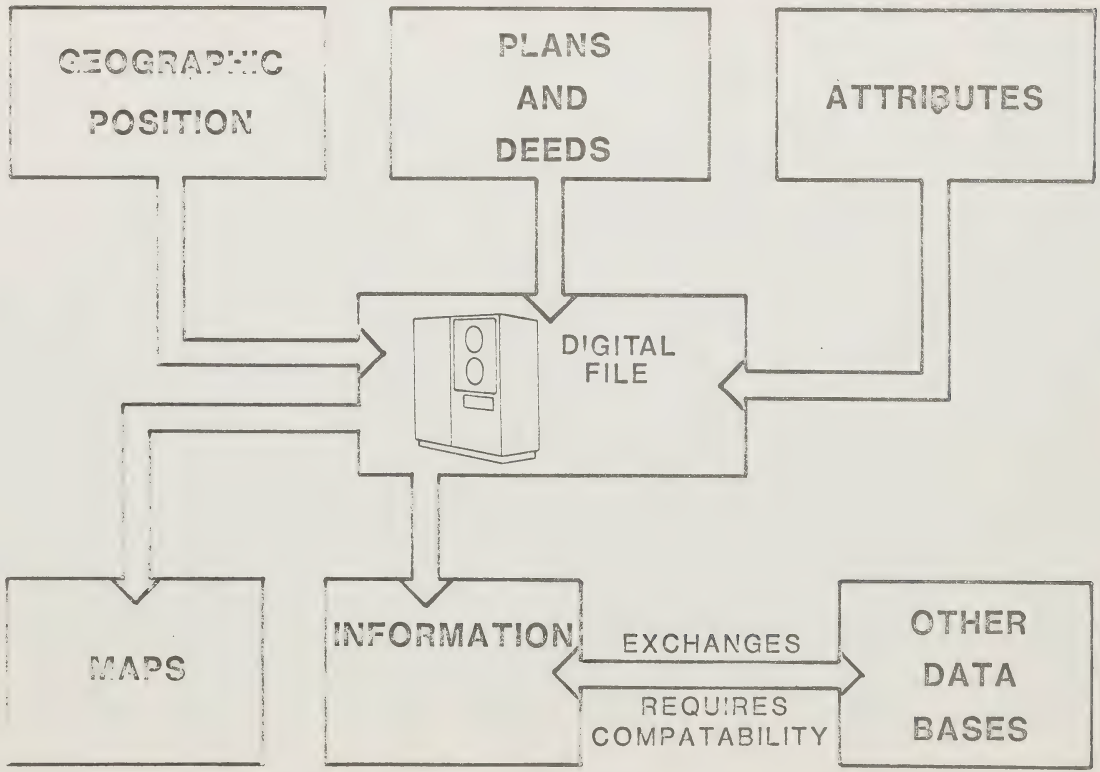
in maps which show township lot framework, cadastral fabric (the registered plan layer) and property ownership, all of which are related to the ground. An example which is close to this type of mapping is provided by Ontario Base Maps which have had the cadastral layer added by a municipality.

The goal of the Land Registration Improvement Project is not just to develop the capability to produce a hard copy property map which can be displayed in a land registration office (LRO). Rather, it is our intention, through the processes outlined above to create a collection of data about land inside a computer. This computerized file will not only describe the geographic location of the parcel boundaries but also such attributes as ownership, encumbrances and possibly land use. By associating with any given parcel a description of its boundaries in UTM coordinates together with data such as value and owner's name, the computer system will have the capability of providing much more than a hard copy property map. This arrangement of this type of data will allow us to combine the data in various ways to produce information which is very useful to government, municipalities, and many agencies in the private sector.

This type of information, which can be related to a specific piece of ground, is of great value to those individuals who are responsible for the management, development, appraisal, taxation or sale of land. The system I have referred to can be described as a georeferencing system.

The opportunity also exists to combine other data which are not resident within the land registration system, such as data on taxation, utilities, zoning, housing, soils, etc. Since these data are collected by other ministries or agencies, who are responsible for their accuracy, completeness and timeliness, ways would have to be developed for exchanging these data with ours.

AN INFORMATION SYSTEM



Such facilities would provide, in the Province of Ontario, a series of digital data files, which contain data about land, and which together form a provincial land data base.

This concept of the ability to exchange information can be referred to as compatibility. Compatibility is essential in order to avoid duplication of information in files or on maps. Compatibility also helps to eliminate the existence of more than one definition of features such as township lots, lake boundaries or properties.

Compatibility also allows greater scope in planning and managing our resources since information from various sources can be combined and it becomes economically feasible to gather much larger amounts of information.

Compatibility is concerned with the extent to which data or maps can be usefully shared by two or more distinct users. In other words, to what extent can user A receive data from user B, merge it with A's own data and obtain information from the combined data?

There are two areas of compatibility which we must investigate. One is thematic mapping and the other is computerization. As far as thematic mapping is concerned, we are interested in the degree to which the Land Registration maps could be used by other organizations. (During the initial map-building period, we are also interested in the extent to which we can use other maps as a source of data.) In the realm of computerization we are interested in our ability to supply land-based data to other organizations and also to receive such data from external sources.

Since a large part of our concern revolves around computerization, we should first identify the ways in which we might use computers. There are three ways in which computerization could occur:

1. Maps can be digitized to provide a graphics file. Such a file describes points, lines and polygons. These may be grouped into classes, e.g. roads, rivers, properties, etc. In effect, this simply provides an automated map drawing facility.

2. "Standard" data processing files which are in use in the electronic data processing field today (e.g. describing owner, tax value, etc. of each property) can be geocoded by having the geographic location of some point within the property (e.g. centroid) added to that property's record.

3. A georeferenced system can be developed which essentially combines the first two. For each property, the single system would contain:
   - data concerning the shape, size and geographic location of the property. This data is sufficient to plot a map of the property, and
   - attribute data such as owner, tax assessment, etc. which is related to specific properties.

The Land Registration Improvement Project could create digital files of information and the required mapping capability using either a combination of the digitized maps plus the standard data processing files which have been geocoded in some manner or it can use a georeferenced system.

A georeferenced system would provide adjacency and would allow for precise geographic analysis which can be combined with non-geographic data. It will also allow questions to be asked concerning the relationships of features (such as properties) and the related attribute data on an "ad hoc" basis. A georeferenced system, however, may be expensive to build.

The combination of digitized maps plus standard data files, on the other hand, requires that questions be pre-defined to a much greater degree so that the ability to provide the answers is built into the

system. It also may be difficult to build in the concept of adjacency.

The objective of compatibility, as far as maps are concerned, can be very easily summarized by stating that it should be possible to overlay two maps of the same area in order to derive composite information. The factors which determine the possibility of doing this are as follows:

- map projection;
- scale;
- size and orientation of area covered;
- equivalent grid cells to allow identification of identical points;
- symbology;
- positional accuracy of:
  - township fabric;
  - cadastral fabric;
  - other features; and
  - map format.

The most basic level of compatibility would be provided if the two map series shares the same

- map projections; and
- scale.

It would then be possible to overlay the two maps to combine their information. If the maps did not cover precisely the same area, the lack of uniform grid cells would complicate (slightly) the process of aligning the two maps. Lack of positional accuracy could result in the same feature appearing in different positions. Different symbologies could make reading the maps difficult.

Increasing levels of compatibility are achieved as more of the last mentioned factors are the same for the maps in question.

It should be noted that if maps are computerized, the question of scale is less important since automatic changes of scale are possible.

Positional accuracy will be the hardest attribute to provide. Provision of complete accuracy would require a multitude of decisions concerning the relative merits of conflicting sources of information. In many cases the LRO data would be more accurate than OBM data and this could necessitate changing the OBM base. Ideally, accuracy would imply that each feature would be defined by one agency. Practical considerations may make this ideal impossible to achieve.

It was previously stated that creation of files of data about land through the use of a georeferencing system would provide the greatest scope in terms of information that could be obtained from that data. The georeferencing system being developed at Guelph is one of many options which will be evaluated in determining the manner in which we may best satisfy our information needs. Essentially, a georeferencing system represents a combination of "standard" data processing files and digitized maps or what has been referred to as a graphics system. The factors that affect compatibility of a georeferencing system, therefore, are the same as those for both "standard" data processing files and a graphics system.

Dr. Linders has already provided an update on the development of the georeferencing system at Guelph and has talked about the development of a comprehensive geographical referencing data base for Ontario. It was recognized, at the beginning of this development work, that the Ministry of Consumer and Commercial Relations was a potential user of information about land in digital form, as well as being a possible producer of such information. MCCR had representation on the Thematic Users Committee and participated in the work that has been completed to this point. As has already been explained by Dr. Linders, various components of the georeferencing system such as:

- data collection procedures;
- an interpreter;
- the file manager;
- editing programmes; and
- plotting programmes,

exist in generalized form and have also been tailored to particular applications such as Ontario Base Mapping and the Forestry application.

The work that has gone into these components is also relevant to MCCRs property mapping application since the last mentioned components are used in any application.

Some work has been undertaken by Dr. Linders and his staff that is particular to the MCCR application. This work consists of:

1. The development of data collection routines to collect data, through the process of digitization, from plans of survey recorded in the Land Registration system.
2. The development of data collection routines to collect data, through the process of digitization, from a finished hard copy property map. This work required that the individual writing the programmes and doing the digitization be aware of the features which exist on such a map and which must be retrieved in the future. Examples of these features are:
   (a) map block. This is a purely arbitrary area defined for administrative purposes within the land registration system. It is intended that the Province will be divided into regions, the regions will be divided into blocks and the blocks will be divided into individual ownerships. This arbitrary division of the Province through the property mapping process will also make possible the creation of hierarchical unique identifiers for each ownership. The unique identifier may consist of region number, block number and property number and will provide a unique label under which information that is particular to that ownership will be filed. This unique identifier is essential if digital files of information are to be created. These unique identifiers will, of course, be cross referenced to existing identifiers such as street address, owner's name, lot and plan number, etc;
   (b) township boundary;
   (c) concession which is a tier of township lots;
   (d) township lot;

(e) original allowances for road;

(f) registered plan boundaries;

(g) blocks, lots and streets within registered plans; and

(h) single ownership.

The data collection procedures must recognize these entities, must code and collect the data in such a way that the entities or features can be retrieved separately or in combination and must provide the awareness of spatial relationships known as adjacency.

The next step in the work at the University of Guelph will provide the interpreter and load the data obtained from the property map from the temporary file into the file manager. Dr. Linders has been asked to provide the capability to obtain a wide range of information from the data in the file manager. The requested capabilities would enable the georeferencing system to provide answers to such questions as:

1. For an arbitrarily defined corridor or polygon, list all properties which -
   (a) fall entirely within it; and
   (b) fall at least partly within it.

   For each property, list the owner's name and address.

2. For a given name, list all properties owned by that person.

3. For a given street, or river, list all the properties (plus owner's name and address) which adjoin it.

4. For a given property, locate all adjoining properties and list the owner's name and address.

These are a few examples which typify the precise geographical analysis of data required to provide information related to specific points or areas on the earth's surface.

Dr. Linders has also been asked to provide certain capabilities related to the process of updating the maps. It will be essential to update the property maps on a daily basis, once they have been built. As

information comes into the land registration system, in the form of plans and documents, creating new divisions of land or consolidating existing ownerships, it must be possible to display this information immediately on property maps in the Land Registration offices. Some examples of the updating capabilities required are:

1. Addition of an entire new subdivision plan, including all contained streets and subdivision units. This could range from being very simple with two or three units to very large with several hundred units;
2. Aggregation of land by the process of one owner buying an adjoining property. The two properties become one new one;
3. An owner selling part of his property to a neighbour. No new property is created, but the boundary line moves; and
4. Addition of a new road or rail allowance.

The system will, of course, be able to plot the features mentioned previously, either singularly, in combination or all together to give hard copy property maps with the relevant annotation such as street names, unique identifiers, etc.

We are rapidly entering an era where new and very exciting technology will radically alter the manner in which we gather data and extract information that is required. We will be able to assemble large volumes of information in amazingly short periods of time in order to better manage our land and resources. It is hoped that both government and the private sector can work together to realize the full potential of automated systems which combine both geographical position and factual data.

Thank you. (Applause)

CHAIRMAN GROOT: Thank you very much. Are there any questions?

Q: MR. T. P. JONES (City of Ottawa): You said that property is the base of the mapping and that other thematic users should use that as their base. Mr. Kerr said the grid cells are the base and should be used by thematic users, and this makes me feel uneasy. You have two separate systems here. Does this cause you any concern or can you live with the grid squares as well as the properties?

A: MR. RAY SCOTT: I don't really see that there is a conflict there — there are really two bases. Certainly the ground is a base, and people will want to relate their own particular features to the ground, and if they want to use the grid cells to evaluate that information or aggregate the information, I do not really see that that is in any conflict to mapping which shows properties.

Q: MR. T.P. JONES: I don't properly understand this. I think of cells as basic units that cannot be split up, and yet a property cell could easily fall into two grid cells.

A: MR. RAY SCOTT: That is quite true and I think if that caused you a problem, you probably would not be aggregating information by grid cells. There is nothing to say you have to use grid cells.

Q: MR. T.P. JONES: You have two systems side by side.

A: MR. RAY SCOTT: You would use grid cells where it is appropriate to the type of information you are trying to gather.

Q: MR. T.P. JONES: You seem to be advocating two systems.

A: MR. RAY SCOTT: Two systems? I don't see that. There is only one system. I don't see that there are two systems involved.

MR. T.P. JONES: Well, as I say, I am uneasy about it.

Q: CHAIRMAN GROOT: Maybe some other speakers can throw some light on this?

M. MICHEL PARADIS (Quebec): As Mr. Jones did, I want to express some surprise. I cannot imagine a comprehensive geographical reference data base that would not include property mapping. It is very important to relate thematic information to property boundaries. Before a decision is taken we want to know who is going to be affected by it. If a road is to pass somewhere, I want to know who is going to be affected. It is particularly important for those who are involved in the simulation business. Property boundaries should be internal to the geographical base of a GEOREF System. Property polygons are not just like other polygons.

CHAIRMAN GROOT: Thank you very much. John Kerr?

MR. JOHN KERR (MNR): I would like to address the issue of grid cells raised by Mr. Jones if I may, for a moment. Each OBM map is in fact a grid cell. The handout you all received yesterday "The Ontario Geographical Referencing Grid" contains a section on a systematic series of grid cells recommended for use by those who reference their data by grid cells. It so happens that the grid cells formed by the neatlines of the OBM maps are part of the systematic series of cells shown in the handout. The reason for this is the OBM system and the systematic series of grid cells are part of a comprehensive geographical referencing system structured on the UTM grid. Grid cells are one of the four basic spatial entities to which most positionally related data can be referenced. The other three are points, lines and polygons. I don't think this, however, is specifically what Mr. Jones was referring to in his question on grid cells.

As I understand it, his concern is that I said earlier that the OBM maps are the reference base for thematic data and Ray Scott has suggested property maps will form the base. It is true that OBM maps in their present form are grid cells and that some properties in the Registry System under MCCR will, in fact, straddle the map neatlines. However, if we eventually digitize the OBM maps and develop a "global" topographic data base, users can window whatever portion of the topographic base they require and display their themes on it. Thus a customized map could be produced to display land parcels.

I know MCCR do not want land parcels divided by map edges, hopefully they won't be if the system can produce customized maps. In the meantime Ray has already mentioned his Ministry will use the OBM maps as a base where they are available including the township fabric and parcel boundaries as superimposed on them by the local surveyors.

Some people are concerned that property ownership is not shown on the OBM maps. Ownership is a theme and if all themes were shown on the base maps you would not be able to read them. Furthermore ownership, like many themes, is dynamic and the base maps would soon be out of date.

Again, we are not developing one system under one roof. We are aiming at a truly integrated system in which the Ministry of Natural Resources will provide the basic planimetry, MCCR will supply the land title information, the Ministry of Agriculture will provide agricultural data, and so on. Right now the standards being developed are paving the way for expediting the exchange of positionally related data between the various users of it. If everyone uses the OBM base, which happens to be one of these standards, it will simplify things. If, however, OBM base maps do not yet exist in an area in which MCCR chooses to develop a land ownership data base, it is expected that when the OBM maps for that area are produced the OBM people will use MCCR's latest information on the parcel boundaries in the production of the new OBM maps.

CHAIRMAN GROOT: Thank you. Any other questions — questions or speeches — questions, I hope?

Q: MR. MARTIN SINCLAIR (Ministry of Housing): Clarification I hope. In the property map you indicate you are going to be showing single ownership. Could you indicate how you are going to handle the highrise condominium or, in other words, the third dimension? (Laughter)

A: MR. RAY SCOTT (MCCR): Next question? No, at this point I really cannot indicate how we are going to handle it. We certainly, of course,

recognize that that is a problem as you have vertical ownership; you have problems of identification, unique identification of vertical ownership, and at the moment we really haven't got far enough down the road that I can give you any concrete answers as yet, as to how we are going to handle that. Where's my chauffeur? (Laughter)

MR. MALCOLM McLEOD (McLeod Curry & Associates): At this late stage in the program I have but two brief comments to add. First, which coordinate grid? 3^{o} MTM? 6^{o} UTM? Lambert Conformal? Stereographic? Today it really does not matter which one as long as each agency picks one and preserves its "thing" in a digital coordinate form or state. Electronic circuitry will, or can convert data onto any other coordinate system on-line at any future time. My second comment concerns data bases. The data base fcr any one agency can be as simple as a gridded piece of paper, e.g. a 6^{o} UTM set of ruled grid lines or as a relatively complete record of existing topographical features, e.g. an OBM map at 1:10 000, whichever.

It behooves everyone here in collecting any information, to relate it either graphically or (preferably) digitally to a "geodetically relatable" data base. The onus of responsibility to data base all rests with the information-gathering agency to act now. No agency needs to wait for an OBM or a digitally-oriented georeferencing system as is proposed during this seminar. Thank you.

CHAIRMAN GROOT: Thank you. I think we should go on to the next speaker. Thank you very much Ray. (Applause)

The next speaker is Leigh Harmeson of the Ontario Hydro. He is going to give an update of the Route and Site Selection System. Leigh graduated in 1969 with a degree in landscape architecture, and he has worked with Ontario Hydro since 1975 on priority projects, collecting information on visual attributes in the Province and for environmental assessment. Now he is assigned responsibility of the computer system development. Leigh. (Applause)

MR. LEIGH HARMESON (Ontario Hydro): Thank you Dick. Ray said he would speed up his presentation so his chauffeur would have time to answer questions. Seeing how my chauffeur is not here, there is no need for me to speed up nor for you to ask questions. This afternoon I am going to explain to you the computer-assisted Route and Site Selection system. We have given it the acronym CARSS. It was developed by Ontario Hydro for the land use and environmental planning. (Power went off.)

— COFFEE BREAK —

CHAIRMAN GROOT: I would like to restart the session. We will now hear from Leigh Harmeson who works for an organization which shall remain unnamed. (Laughter) Please, Leigh, go ahead.

MR. LEIGH HARMESON: To prevent power failures in the future, John, I think you had better pay your Hydro bills on time. (Laughter). Before starting I would like to apologize for the poor quality of the graphics I will be presenting. However, they are necessary to clarify some of the points I will be making.

UPDATE ON THE ONTARIO HYDRO'S COMPUTER ASSISTED ROUTE AND SITE SELECTION SYSTEM

MR. LEIGH HARMESON
ONTARIO HYDRO

As early as 1972, due to an anticipated expansion of Ontario Hydro facilities, and their requirement to involve the public in considering non-engineering factors when locating those facilities, it was recognized at Ontario Hydro that a georeference information system capable of handling large volumes of information was going to be required. CARSS was developed: 1) to provide for the input, the manipulation and output of large volumes of map data; 2) provide for a geographical referencing base for this data — a 6^{o} UTM was chosen in this case; and 3) function on a grid or cellular system yet maintain known and acceptable levels of data integrity.

Through the period from 1972 to date, CARSS has also evolved to allow for the evaluation of georeferenced information using specifically developed programs, developed text and/or graphics output for the evaluation results, produced map output of a quality suitable for public presentation and provide a system that is efficient, understandable and accessible to the user. CARSS is dynamic in the fact that it is constantly changing to better meet the needs of its users. We find more and more shall we say rough points with it that have to be ironed out, and we continually work on these. CARSS presently utilizes two computer systems, an on-site PDP 11/70 and Ontario Hydro's Univac Centre to meet these requirements.

The input, storage of non-cellular map information and graphic output are handled by the PDP system. Manipulation of cellular information and evaluations are handled by the Univac. Storage of cellular information can be handled by either system, and a communication link between the computers is magnetic tape. Before information is input, manipulated or output, it is advisable that consistent terminology be established and used by all those involved in the system. And this

afternoon I am going to go ahead and abuse this statement, because I'm caught like many people; I will discuss words such as polygons and areas being the same. I might talk about data types or attributes, grid cells or cells, to me these are one and the same.

Going on then, to the input of the mapped information. Mapped information that is illustrated as a point, line or an area, can be recorded, and recording is by means of a free arm digitizer. As Zul mentioned, the digitizer is merely a translator of the illustrations into a digital format for the computer's use. The operator of the digitizer interacts with the computer through questions prompted by a CRT by selected program and responds appropriately.

SLIDE 1:

SEE SLIDE — Page 265

This interaction has been a source of refinement over the past year to better meet the human requirements of this operation.

On Slide 2 is one of the programs that will come up after access to any one of the project files. This is a subsequent set of menus from the previous one merely by where it asks for a number, an option number placing in the number and the next stage will come up either being a subsequent menu or right into the program itself.

SLIDE 2:

SEE SLIDE — Page 266

We have found that well defined procedures for input and rigid standards for illustration of the mapped information has resulted in reducing recording time and increasing our productivity. I would like to emphasize what Dr. Linders had to say the other day about getting it right the first time. Editing is expensive and is time-consuming and most of all it is very frustrating to those people who must input the information.

The following are some of our requirements: Every map must have four distinct and accurate points for referencing. These can be latitude/longitude points or UTM (presently the only projection system is the

```
CARSS>HELLO [200,4]
CARSS>@[100,1]RUNALL
>RNZ CLEAR

>;**********************************************************************
>;*                                                                    *
>;*                 ROUTE AND SITE SELECTION SYSTEM                    *
>;*                           PRIMARY MENU                             *
>;*--------------------------------------------------------------------*
>;*            THE FOLLOWING PRIMARY OPTIONS ARE AVAILABLE :           *
>;*                                                                    *
>;*      1 - PLOT(MAPS,HIST)              5 - AREA UPDATE             *
>;*      2 - DIGITIZE AND WEED            6 - ROLLIN (AREA,CELL,HIST) *
>;*      3 - CELL MERGE                   7 - ROLLOUT (CONCAT CELL FILES) *
>;*      4 - CELL CLEANUP                 8 - DUMP FILES              *
>;*                                       9 - CONVERT (AREA TO CELL)  *
>;*                                                                    *
>;*                              PLUS                                  *
>;*                                                                    *
>;*                 D - DISPLAY PRIMARY MENU                           *
>;*                 E - EXIT AND TERMINATE SESSION                     *
>;*                                                                    *
>;*          (PLEASE SELECT ONE AND SPECIFY IN FIELD BELOW)            *
>;**********************************************************************
>;
>* ENTER OPTION NUMBER ====> [S]: 2
>RNZ CLEAR
```

Slide 1

```
>;*************************************************************************
>;*                                                                       *
>;*        D I G I T I Z E   AND   W E E D   P R O G R A M S              *
>;*                              MENU                                     *
>;*-----------------------------------------------------------------------*
>;*                                                                       *
>;*         THE FOLLOWING DIG & WEED OPTIONS ARE AVAILABLE :              *
>;*                                                                       *
>;*                     1 - SONIC DIGITIZER                               *
>;*                     2 - CALCOMP DIGITIZER                             *
>;*                                                                       *
>;*                             PLUS                                      *
>;*                             ****                                      *
>;*                                                                       *
>;*            D OR <CR> - DISPLAY PRIMARY MENU                           *
>;*            E         - EXIT AND TERMINATE SESSION                     *
>;*                                                                       *
>;*         (PLEASE SELECT ONE AND SPECIFY IN FIELD BELOW)                *
>;*************************************************************************
>;
>* ENTER OPTION NUMBER ====> [S]: 2
>RNZ CLEAR

>;*************************************************************************
>;*                                                                       *
>;*              C A L C O M P    DIGITIZE AND WEED                       *
>;*                              MENU                                     *
>;*-----------------------------------------------------------------------*
>;*          THE FOLLOWING CALCOMP OPTIONS ARE AVAILABLE :                *
>;*                                                                       *
>;*   1 - DIGITIZE ORIGINAL(A,P,L)     5 - DIGITIZE CELL CORRECTIONS      *
>;*   2 - WEED     ORIGINAL(A,P,L)     6 - WEED     CELL CORRECTIONS      *
>;*   3 - DIGITIZE MULT ATT AREAS      7 - DIGITIZE AREA CORRECTIONS      *
>;*   4 - WEED     MULT ATT AREAS      8 - WEED     AREA CORRECTIONS      *
>;*                                                                       *
>;*                             PLUS                                      *
>;*                             ****                                      *
>;*                                                                       *
>;*                 <CR> - DISPLAY PREVIOUS MENU                          *
>;*                 D    - DISPLAY PRIMARY MENU                           *
>;*                 E    - EXIT AND TERMINATE SESSION                     *
>;*                                                                       *
>;*          (PLEASE CHOOSE ONE AND SPECIFY IN FIELD BELOW)               *
>;*************************************************************************
>;
>* ENTER OPTION NUMBER ====> [S]: 1
```

Slide 2

UTM projection). All areas on the map must close and the closure should be well defined. All symbols should be identified on the map or have an accompanying legend. If the study area extends beyond one map sheet, areas overlapping map sheets should be checked for accuracy of boundary lines and values between map sheets. All this sounds simple enough, but I would not be mentioning it if it doesn't occur quite often. Lines representing classification boundaries of thematic data should be as thin as possible. Planners expect that when they hand it to an operator that is digitizing, using a piece of tape or crayola mark of a quarter inch wide, that the digitizer operator will understand whether to trace the middle of the line, the inside edge or the outside edge.

Another form of input to the system is cells. Information must be converted to cellular format for purposes of manipulation and evaluation. The cell size selected can vary from a maximum of 5000 x 5000 metres to a minimum of 10 x 10 metres. As you noticed, we do not force planners to choose a standard cell size as in the OBM system. Whether this will occur in the future when OBM comes on, I do not know. The size selected of the cell will depend on the degree of accuracy required for making a decision, the accuracy of the recorded area information (polygon information) and the computer funds available for the manipulation and evaluation of this information. Cells can either be input individually by using the digitizer or by converting stored area information using a developed conversion program.

<u>Slide 3</u>: <u>Convert Polygons to Cells</u>

SEE SLIDE — Page 268

The appropriate computer program will request the cell size (in metres) you want, the name of the area file you wish to convert, do its thing, request an output file, are you sure you are correct? and assign an output file. The routine is quite efficient and fast. Some of the testing that I have done recently on the FARINEO information in eastern Ontario, in one particular township, by selecting a cell size that I

```
>@[76,1]CONVERT
>;   CONVERT.CMD -  CONVERT POLYGONS TO CELLS
>;
>TIME
13:15:18 04-MAR-81
>RUN [76,1]CONVERT

ENTER CELL SIZE (METERS): 500

ENTER AREA FILE NAME:1MIBU.AR
TT4  --  STOP

>SRT CELFILX.SRT=CELFILX.DAT/SIZE:45/KEYS:CN1.7:CN8.7/PR:A
SRT -- TOTAL RECORDS SORTED:          24
>RUN [76,1]OVERLAP

ENTER NAME OF OUTPUT CELL FILE : TEST.CL


IS THE ABOVE CORRECT?   [Y/N]  : Y


      24 STRIPS PROCESSED
TT4  --  STOP

>TIME
13:16:09 04-MAR-81
>;
>;  END POLYGON-CELL CONVERSION
```

Slide 3

felt was appropriate, for the information that had been recorded, converted to about 5000 cells in less than two minutes. The changes that I had to make were less than 5%.

Because information is recorded incorrectly, updated, or not converted to cells exactly as the planner wished, an editing routine was developed. Again the digitizer is the primary device for editing. The editing routines allow for removing or adding new areas or cells, or merely changing the value code for the data itself.

Once all the information is recorded correctly as cells, manipulation and evaluation can take place. In the manipulation, we have routines that allow planners to derive data from recorded or previously derived data. The routines can handle, combining hundreds of layers of information over a horizontal area, approximately 100,000 cells (the cell size does not matter in this creation of this new data). Hundreds of derived data can be created at one time and the routine can work with codes as either character functions or as numerical values (if mathematical models are desired). At this point I would like to carry you through an example that actually occurred on one project where the piece of information that was desired was: The location within the study area of Class 2 timber productivity land that is either forested with trees of a saleable size, or it was forested but has been disturbed by cutting, wind or fire.

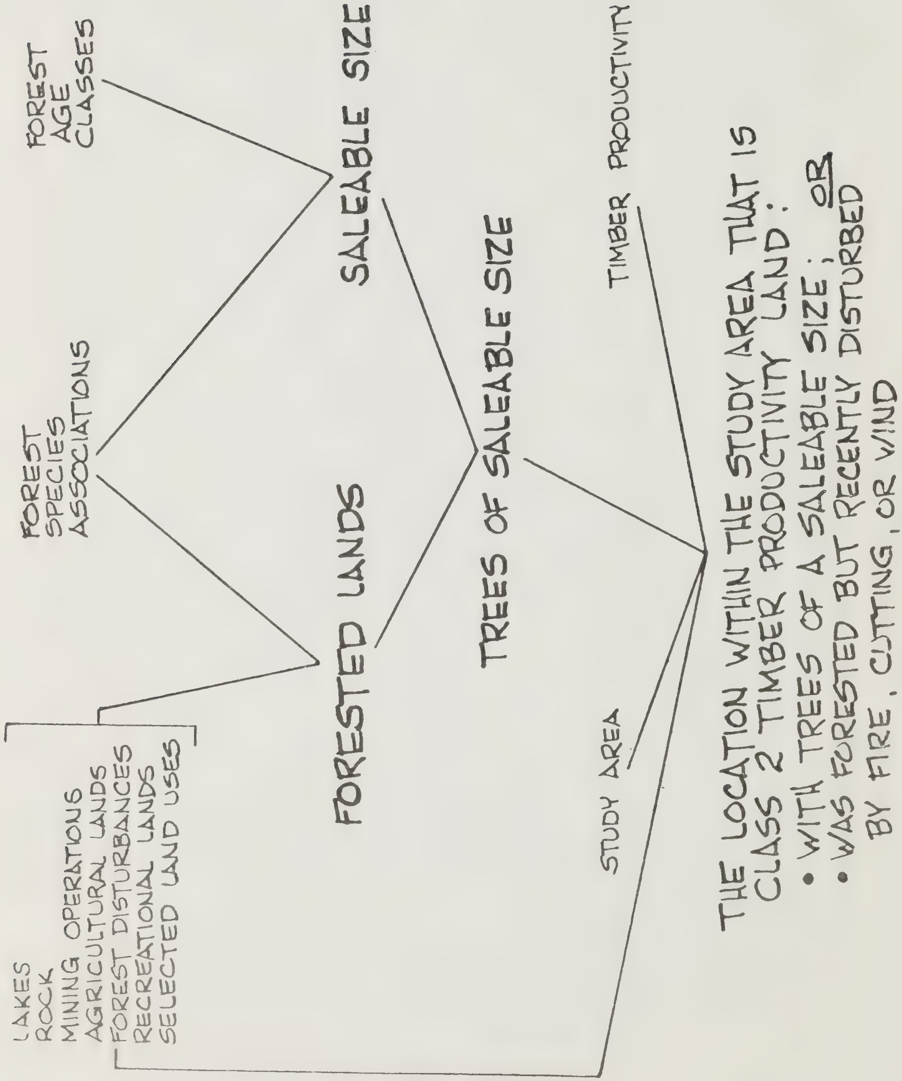
Slide 4: Model

SEE SLIDE — Page 270

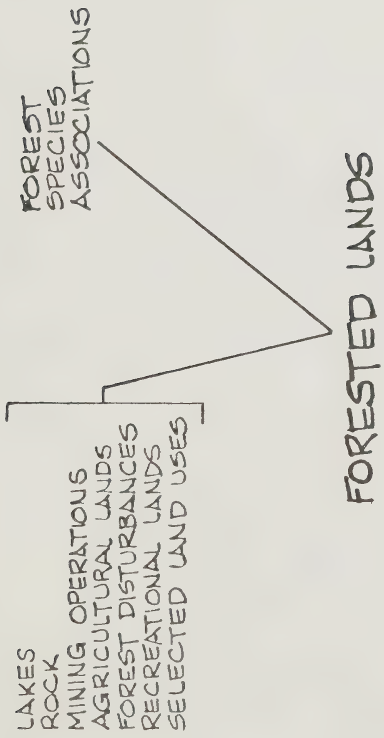
The finer print on here is the information that we have recorded through the digitizing system, and in getting to this overall piece of derived information, we derived subsequent sets in between, in this case Forested Lands.

Slide 5: Forested Lands

SEE SLIDE — Page 271


LAKES
ROCK
MINING OPERATIONS
AGRICULTURAL LANDS
FOREST DISTURBANCES
RECREATIONAL LANDS
SELECTED LAND USES
FORESTED LANDS
FOREST SPECIES ASSOCIATIONS
FOREST AGE CLASSES
SALEABLE SIZE
TREES OF SALEABLE SIZE
STUDY AREA
TIMBER PRODUCTIVITY
THE LOCATION WITHIN THE STUDY AREA THAT IS CLASS 2 TIMBER PRODUCTIVITY LAND:
• WITH TREES OF A SALEABLE SIZE; OR
• WAS FORESTED BUT RECENTLY DISTURBED BY FIRE, CUTTING, OR WIND

Slide 4


FORESTED LANDS
FOREST
SPECIES
ASSOCIATIONS
LAKES
ROCK
MINING OPERATIONS
AGRICULTURAL LANDS
FOREST DISTURBANCES
RECREATIONAL LANDS
SELECTED LAND USES

Slide 5

The forest species association map for this area is continuous coverage.

Slide 6: Forest Species Association

SEE SLIDE — Page 273

We wish to adjust this map by taking out lakes, rock information (the graphics were produced at different scales and registration was not adhered to so that is why we find rock in the middle of the lakes).

Slide 7: Lakes

SEE SLIDE — Page 274

Slide 8: Rock

SEE SLIDE — Page 275

We get things like mining, agricultural lands, disturbances to forest cover, recreational lands, selected land use overlaying and as you can tell, it is becoming quite muddy. This is one reason for getting away from a manual system. You can tell by the set of the routines we end up with a new piece of data now called Forested Areas Available for Timber Production.

Slide 9: Forested Areas Available for Timber Production

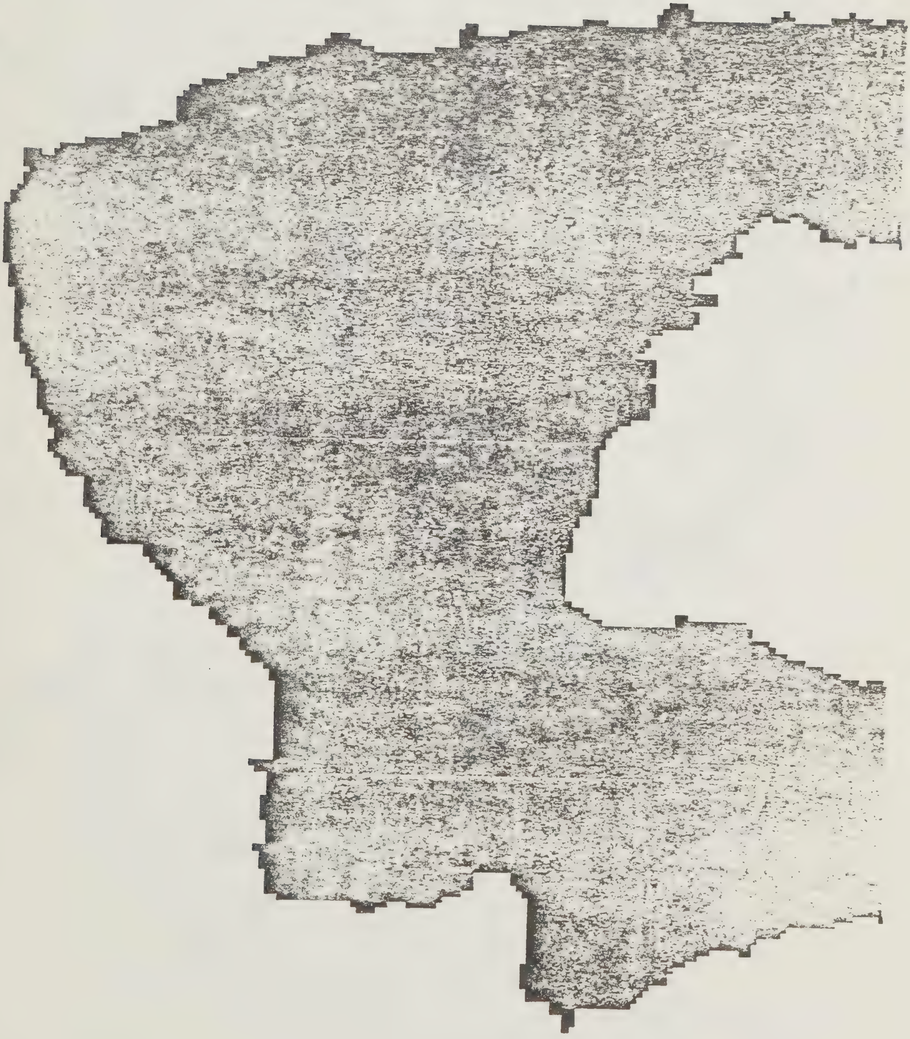
SEE SLIDE — Page 276

Once I have that map, then I can continue on through the creation of a new piece of data.

Slide 10: Trees of Saleable Size

SEE SLIDE — Page 277

The next thing we want to know is what is a saleable size tree. Through a modelling technique of combining forest species associations with forest age classes, we can determine Saleable Size (I do not have a map of this). We can get into the area where we have trees of saleable size now, by combining the forested lands along with the saleable size.



FOREST SPECIES ASSOCIATION

Slide 6

LAKES

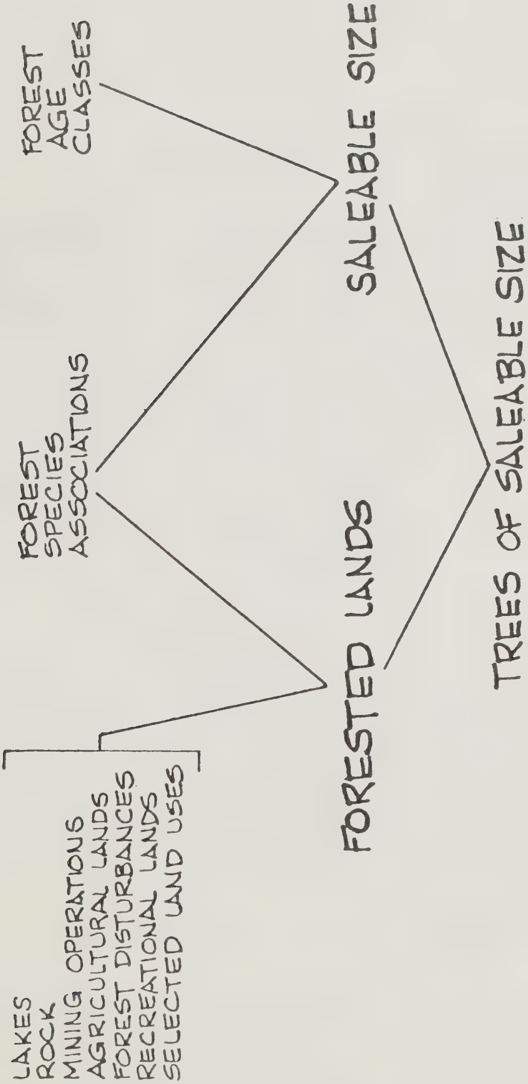
Slide 7

ROCK

Slide 8

FORESTED AREAS AVAILABLE FOR TIMBER PRODUCTION

Slide 9


LAKES
ROCK
MINING OPERATIONS
AGRICULTURAL LANDS
FOREST DISTURBANCES
RECREATIONAL LANDS
SELECTED LAND USES
FORESTED LANDS
FOREST SPECIES ASSOCIATIONS
FOREST AGE CLASSES
SALEABLE SIZE
TREES OF SALEABLE SIZE

Slide 10

I take it back . . what I've got here is the forested areas available for timber production. Here is the Saleable Size Trees, the black area which is the piece of data that we're looking at is continuing to diminish as we take more and more pieces out. We now have Trees of Saleable Size.

Slide 11: Saleable Size Trees

SEE SLIDE — Page 279

We also have, if you remember, an area called forest disturbances in which we have areas that were disturbed by fire, cutting or wind. There's our Saleable Size Trees again; our disturbances that we want to put back into the model, our productivity class, our study area that we want to clip to. Finally we come to the end product.

Slide 12: Timber Productivity Class 2

SEE SLIDE — Page 280

Slide 13: Study Area

SEE SLIDE — Page 281

Slide 14: Model Product

SEE SLIDE — Page 282

This is all done at one time. Within the computer there is not subsequent steps that the planner would ever notice or have to do in a manual system. I can also continue on this thing if I want; I can put all the timber information that was generated by people into what we classify as a factor map, or a family of timber production; the black here being those areas that you saw produced before.

Slide 15: Timber Production

SEE SLIDE — Page 283

What you see here, generated by the computer for purposes of being

Slide 16: Commands

SEE SLIDE — Page 284

SALEABLE SIZE TREES

Slide 11

TIMBER PRODUCTIVITY CLASS 2

Slide 12

STUDY AREA

Slide 13

THE LOCATIONS WITHIN THE STUDY AREA OF CLASS 2 TIMBER PRODUCTIVITY LAND THAT IS EITHER FORESTED WITH TREES OF A SALEABLE SIZE OR WAS FORESTED BUT HAS BEEN DISTURBED BY CUTTING, WIND, OR FIRE

Slide 14

TIMBER PRODUCTION

Slide 15

```
 DEFINE-HM184.
*                             ***   HM184   ***
*
*    AREAS CHARACTERIZED BY TIMBER PRODUCTIVITY CLASS 2
*    WITH TREES OF SALEABLE SIZE OR DISTURBED FOREST COVER
*
*    DERIVED FROM: TIMPR - TIMBER PRODUCTIVITY
*                  FORMN - FOREST MANAGEMENT AREAS
*                  HMX60 - TREES OF SALEABLE SIZE
*
*
*    INITIALIZE
                                MOVE LOW-VALUES  TO CHM184.
*
*    CUT.OVER
     IF CFORMN     = '01   '    MOVE '00100 '    TO CHM184.
*
*    WIND BLOWN
     IF CFORMN     = '02   '    MOVE '00100 '    TO CHM184.
*
*    OTHER DISTURBANCES, FIRE, CHEMICAL, ETC
     IF CFORMN     = '03   '    MOVE '00100 '    TO CHM184.
*
     IF CHMX60 NOT = LOW-VALUES MOVE '00100 '    TO CHM184.
*
     IF CTIMPR NOT = '02   '    MOVE LOW-VALUES  TO CHM184.
*
 END-HM184.
     EXIT.
```

able to put in hard copy for someone's records, are the commands for the final set when we did put together timber productivity along with the forest management areas and trees of saleable size. The study area was an overall clip of all derived data so it is not mentioned here. As you can see we do describe the new data and we have identi- where it is derived from.

What is required from the planner, to get a statement of what you just saw, is merely a few lines like this.

Slide 17: Planner Requirement

SEE SLIDE — Page 286

These three lines created the previous statement.

After manipulating the data in the format that I wish I can get into further development of constraint mapping; from constraint mapping, I can continue into the development of alternatives or identification of alternatives. The system does not have a route finder system within it. That is done manually through the planners in conjunction with the public; we have found this more acceptable publicly than by putting in a number cruncher that will generate the "least impact" routes.

An evaluation routine has been developed that enables the planner to evaluate each alternative and to compare any number of alternatives. This routine produces information that the planner can use to determine how well each alternative accommodates the environmental concerns and hence which alternative is more acceptable from an environmental perspective. The black here being some linear geographical areas in which

Slide 18:

SEE SLIDE — Page 287

the facilities could be accommodated. The planner must generate — must delineate these geographical areas which can accommodate the system facilities. These geographic alternatives are required and stored as

general purpose card punching form

system		punching instructions	punch code	sheet
program		written as	☐ IBM 360	
programmer	date	punch as	☐ univac 1108	of

field identification

```
DERIVE HM184 00100  OR FORMN, EQ, 01  FORMN, EQ, 02  FORMN, EQ, 03   ;
                       HMX80, NE, EMPTY
DERIVE HM184 EMPTY  OR TIMPR, NE, 02
```

Slide 18

any other piece of map information.

Tabulated information can be requested on the number of cells and the hectares for any stored information that occurs within the delineated geographic area. The planner can also attach non-geographical

Slide 19:

SEE SLIDE — Page 289

characteristics, such as conceptual length and width. These characteristics are used in determining an estimate of the length and area of all the stored information that is shown in the count and might be encountered by the proposed facility.

Slide 20:

SEE SLIDE — Page 290

These estimated effects can further be compared to an expected effect or base system, and the differences expressed as a positive or negative deviation.

Slide 21:

SEE SLIDE — Page 291

The evaluation program is a fourth step process. Each step is distinct and can be saved for possible variations to conceptual characteristics being used.

Another aspect of the system is its output capability. Information can be portrayed as maps, tables or charts using the electrostatic plotter that we have. These plots can be produced usually in five to forty-five minutes, sometimes longer depending on the complexity and amount of information to be plotted. Going back to the early menu that we had if we went into the plot program, the following options are available, map plots and histograms. Maps can be plotted with the information portrayed with area or cell outlines; shaded areas or cells (we presently have seventeen patterns); labelled cells or any combination of the above. We can also output lines (seventeen patterns). We can overlay a maximum of four area files, one cell file and two line files simultaneously.

JANUARY 14, 1981

HANMER X MISSISSAGI

HMAR1

A ROUTE ALTERNATIVE - NORTH TO NORTH

CELL EDGE LENGTH = 200 METERS
TOTAL NUMBER OF CELLS = 3585
TOTAL AREA = 14340 HECTARES

ATTRIBUTE CODE	VALUE CODE	NUMBER OF CELLS	AREA (HECTARES)	% COVERAGE	ATTRIBUTE - VALUE TITLE
HMFAL	05	191	764	5.3	VISUAL ENVELOPES OF DEFINED EDGES
HMFAP	01	23	92	0.6	ACTIVE/INACTIVE FARMLAND ON SOIL CAP CL 2,3,4
HMFAP	02	5	20	0.1	FORESTED LANDS ON CL 2,3 SOIL CAP FOR AG PROD
HMFAP	03	427	1708	11.9	CLEARED LAND ON CL 5,6 OR FORESTED ON CL 4 SOIL
HMFBR	01	22	88	0.6	RARE MATURE HEMLOCK OR EXTREMELY MATURE FROESTS
HMFBR	02	232	928	6.5	AREAS OF SWAMP OR TREED OR OPEN WETLAND
HMFBR	04	60	240	1.7	AREAS OF WATERFOWL HABITAT AND STAGING
HMFFR	01	2	8	0.1	AREAS OF HIGH EROSION RISK RELATED TO STREAM VAL
HMFFR	02	55	220	1.5	IDENTIFIED FISHERIES AT LEAST 1.5 KM FROM A ROAD
HMFFR	03	82	328	2.3	IDENTIFIED SELF-SUSTAINING FISHERIES
HMFHS	01	112	448	3.1	VIEWSHEDS OF TOWNS EXCEPT FOR SELECTED AREAS
HMFMR	01	2	8	0.1	ACTIVE/INACTIVE OPEN PITS OR MINE FACILITIES
HMFMR	02	91	364	2.5	LICENSED OR UNLICENSED PITS AND QUARRIES
HMFMR	03	15	60	0.4	EXISTING AND PLANNED URANIUM WASTE DISPOSAL SITES
HMFMR	04	302	1208	8.4	POTENTIAL SAND AND GRAVEL SITES
HMFRR	01	3	12	0.1	VIEWSHEDS OF EXISTING AND PROPOSED COTTAGES
HMFRR	02	124	496	3.5	FOOT TRAILS/CANOE RTES & SCENIC RIV VALLEY
HMFTP	02	102	408	2.8	PLANTATIONS OR REGENERATION AREAS
HMFTP	03	922	3688	25.7	TIMBER PRODUCTIVITY CLASS 1
HMFTP	04	266	1064	7.4	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 2
HMFTP	05	920	3680	25.7	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 2
HMFTP	06	85	340	2.4	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 3
HMFTP	07	218	872	6.1	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 3
HMFWR	03	131	524	3.7	MOOSE CONCENTRATIONS AT LEAST 3.0 KM FROM A ROAD

Slide 19

JANUARY 14, 1981

HANMER X MISSISSAGI

HMAR1

A ROUTE ALTERNATIVE - NORTH TO NORTH

CELL EDGE LENGTH	=	200 METERS
CONCEPTUAL LENGTH	=	218800 METERS
CONCEPTUAL AREA	=	1597 HECTARES
TOTAL NUMBER OF CELLS	=	3585
TOTAL AREA	=	14340 HECTARES

ATTRIBUTE CODE	VALUE CODE	NUMBER OF CELLS	AREA (HECTARES)	% COVERAGE	ESTIMATED AFFECTED LENGTH	ESTIMATED AFFECTED AREA	ATTRIBUTE - VALUE TITLE
HMFAL	05	191	764	5.3	11596	84	VISUAL ENVELOPES OF DEFINED EDGES
HMFAP	01	23	92	0.6	1312	9	ACTIVE/INACTIVE FARMLAND ON SOIL CAP CL 2,3,4
HMFAP	02	5	20	0.1	218	1	FORESTED LANDS ON CL 2,3 SOIL CAP FOR AG PROD
HMFAP	03	427	1708	11.9	26037	190	CLEARED LAND ON CL 5,6 OR FORESTED ON CL 4 SOIL
HMFBR	01	22	88	0.6	1312	9	RARE MATURE HEMLOCK OR EXTREMELY MATURE FROESTS
HMFBR	02	232	928	6.5	14222	103	AREAS OF SWAMP OR TREED OR OPEN WETLAND
HMFBR	04	60	240	1.7	3719	27	AREAS OF WATERFOWL HABITAT AND STAGING
HMFFR	01	2	8	0.1	218	1	AREAS OF HIGH EROSION RISK RELATED TO STREAM VAL
HMFFR	02	55	220	1.5	3282	23	IDENTIFIED FISHERIES AT LEAST 1.5 KM FROM A ROAD
HMFFR	03	82	328	2.3	5032	36	IDENTIFIED SELF-SUSTAINING FISHERIES
HMFHS	01	112	448	3.1	6782	49	VIEWSHEDS OF TOWNS EXCEPT FOR SELECTED AREAS
HMFMR	01	2	8	0.1	218	1	ACTIVE/INACTIVE OPEN PITS OR MINE FACILITIES
HMFMR	02	91	364	2.5	5470	39	LICENSED OR UNLICENSED PITS AND QUARRIES
HMFMR	03	15	60	0.4	875	6	EXISTING AND PLANNED URANIUM WASTE DISPOSAL SITES
HMFMR	04	302	1208	8.4	18379	134	POTENTIAL SAND AND GRAVEL SITES
HMFRR	01	3	12	0.1	218	1	VIEWSHEDS OF EXISTING AND PROPOSED COTTAGES
HMFRR	02	124	496	3.5	7658	55	FOOT TRAILS/CANOE RTES & SCENIC RIV VALLEY
HMFTP	02	102	408	2.8	6126	44	PLANTATIONS OR REGENERATION AREAS
HMFTP	03	922	3688	25.7	56231	410	TIMBER PRODUCTIVITY CLASS 1
HMFTP	04	266	1064	7.4	16191	118	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 2
HMFTP	05	920	3680	25.7	56231	410	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 2
HMFTP	06	85	340	2.4	5251	38	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 3
HMFTP	07	218	872	6.1	13346	97	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 3
HMFWR	03	131	524	3.7	8095	59	MOOSE CONCENTRATIONS AT LEAST 3.0 KM FROM A ROAD

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JANUARY 14, 1981

HANMER X MISSISSAGI

HMAR1

A ROUTE ALTERNATIVE - NORTH TO NORTH

SYSTEM CELL EDGE LENGTH = 200 METERS
SYSTEM CONCEPTUAL LENGTH = 218800 METERS
SYSTEM CONCEPTUAL AREA = 1597 HECTARES
SYSTEM TOTAL NUMBER OF CELLS = 3585
SYSTEM TOTAL AREA = 14340 HECTARES

AVERAGE CONCEPTUAL LENGTH = 222600 METERS
AVERAGE CONCEPTUAL AREA = 1625 HECTARES

ATTRIB. CODE	VALUE CODE	ESTIMATED AFFECTED LENGTH	EXPECTED AFFECTED LENGTH	% DEV.	ESTIMATED AFFECTED AREA	EXPECTED AFFECTED AREA	% DEV.	
HMFFR	03	5032	8236	-39	36	60	-40	IDENTIFIED SELF-SUSTAINING FISHERIES
HMFHS	01	6782	7346	-8	49	54	-9	VIEWSHEDS OF TOWNS EXCEPT FOR SELECTED AREAS
HMFHS	02	0	TRACE	-100	0	TRACE	-100	INDUSTRIAL, COMMERCIAL, OR INSTITUTIONAL AREAS
HMFHS	03	0	223	-100	0	2	-100	AIRSTRIPS.SEA PLANE BASES, OR COMMUNICATION TOWR
HMFMR	01	218	890	-76	1	7	-86	ACTIVE/INACTIVE OPEN PITS OR MINE FACILITIES
HMFMR	02	5470	2671	+105	39	20	+95	LICENSED OR UNLICENSED PITS AND QUARRIES
HMFMR	03	875	890	-2	6	7	-14	EXISTING AND PLANNED URANIUM WASTE DISPOSAL SITES
HMFMR	04	18379	19144	-4	134	140	-4	POTENTIAL SAND AND GRAVEL SITES
HMFMR	05	0	1558	-100	0	11	-100	MINE WASTE DISPOSAL SITES OTHER THAN URANIUM
HMFRR	01	218	18031	-99	1	132	-99	VIEWSHEDS OF EXISTING AND PROPOSED COTTAGES
HMFRR	02	7658	7346	+4	55	54	+2	FOOT TRAILS/CANOE RTES & SCENIC RIV VALLEY
HMFRR	03	0	TRACE	-100	0	TRACE	-100	UNIQUE/SPECIAL TOPOLOGICAL FEATURES IDENT BY MNR
HMFRR	04	0	445	-100	0	3	-100	PRIVATE RECREATN AREAS, LOCAL PARKS, CONSER AREA
HMFRR	05	0	890	-100	0	7	-100	AREAS OF HIGH RECREATION CAPABILITY
HMFTP	01	0	890	-100	0	7	-100	SEED COLLECTION AREAS OR EXPERIMENTAL PLOTS
HMFTP	02	6126	15359	-60	44	112	-61	PLANTATIONS OR REGENERATION AREAS
HMFTP	03	56231	33390	+68	410	244	+68	TIMBER PRODUCTIVITY CLASS 1
HMFTP	04	16191	12243	+32	118	89	+33	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 2
HMFTP	05	56231	53424	+5	410	390	+5	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 2
HMFTP	06	5251	3562	+47	38	26	+46	UNSALEABLE SIZE TREES ON TIMBER PROD CLASS 3
HMFTP	07	13346	20702	-36	97	151	-36	SALEABLE SIZE TREE/DISTURBED FOREST - TIMB CL 3
HMFWR	01	0	1336	-100	0	10	-100	CONIFER SHELTER BELTS WITHIN DEER YARDS
HMFWR	02	0	11353	-100	0	83	-100	DEER YARDS OUTSIDE OF CONIFER SHELTER BELTS
HMFWR	03	8095	6901	+17	59	50	+18	MOOSE CONCENTRATIONS AT LEAST 3.0 KM FROM A ROAD

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As I said on the display over here, Laura has similar graphics and they show considerably better the graphic capabilities of the system. Other aspects of the plot program are output of any scale up to seven digits, and a title block that contains the computer codes for attribute names and values, the surface area for an attribute value in hectares, the line length for an attribute value in kilometres, the scale of the map and date produced. I should warn you that length and area measurements are done using the electrostatic plotter and are therefore subject to the accuracy of the output scale. Also what comes out with the plot is what we call a plot log.

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A plot log describes the information used, the scale, the geographic window and the time required for the plot and the patterns used in your shading.

As I said before, the other aspect that we have is the plotting of histograms (these are a simplification or another output format used in the evaluation of the deviations).

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That basically is the system at present. As for the future, in the short term we are going to spend considerable time in documenting the system and bringing it up to a level that we feel is suitable in documentation for use by other planners in Hydro. Another area is education. It has been a time since we have been to all of our planners with a presentation to show them what is there now. We are going to continue to refine the programs for errors and efficiency, and we're looking at being able to edit on a graphic CRT screen this year. In the long term we are looking for input using an optical device, and also the creation of a data base, which we do not have right now, which will allow us to tag on textual information such as accuracy, the date it was recorded, possible aspects like this. And that's it. (Applause)

```
ROUTE AND SITE MAPPING PROGRAM
STARTING AT Ø9:42:29 ON 2Ø-JUN-8Ø

ENTER SCALE:
------------  3ØØØØ

ENTER 7 DIGIT UTM WINDOW;
              WESTERN EDGE :
--------------------------7498ØØØ
              EASTERN EDGE :
--------------------------7512ØØØ
              SOUTHERN EDGE:
--------------------------5164ØØØ
              NORTHERN EDGE:
--------------------------5176ØØØ

IS THE ABOVE CORRECT ? [Y/N]:
-----------------------------Y

DO YOU WANT TO MAP CELLS? [Y/N]:
--------------------------------Y

ENTER CELL FILE NAME:
---------------------EY.CL

DO YOU WANT TO OUTLINE THE CELLS? [Y/N]:
-----------------------------------------Y

DO YOU WANT TO SHADE THE CELLS?   [Y/N]:
-----------------------------------------Y

DO YOU WANT THESE CELLS ANNOTATED? [Y/N]:
-----------------------------------------N

ENTER PATTERN NUMBER FOR EY    Ø3   :
-------------------------------------   3

ENTER PATTERN NUMBER FOR EY    Ø2   :
-------------------------------------   2

NOTE: MAXIMUM OF  1 FILES REACHED!

DO YOU WANT TO MAP AREAS? [Y/N]:
--------------------------------Y

ENTER AREA FILE NAME:
---------------------EY.AR

DO YOU WANT TO OUTLINE THE AREAS?  [Y/N]:
-----------------------------------------Y

DO YOU WANT TO SHADE THE AREAS?    [Y/N]:
-----------------------------------------N

DO YOU WANT TO OVERLAY MORE AREAS? [Y/N]:
-----------------------------------------N

DO YOU WANT LINEAR FEATURES? [Y/N]:
----------------------------------------------------N

END MAP AT Ø9:45:31 ON 2Ø-JUN-8Ø
```

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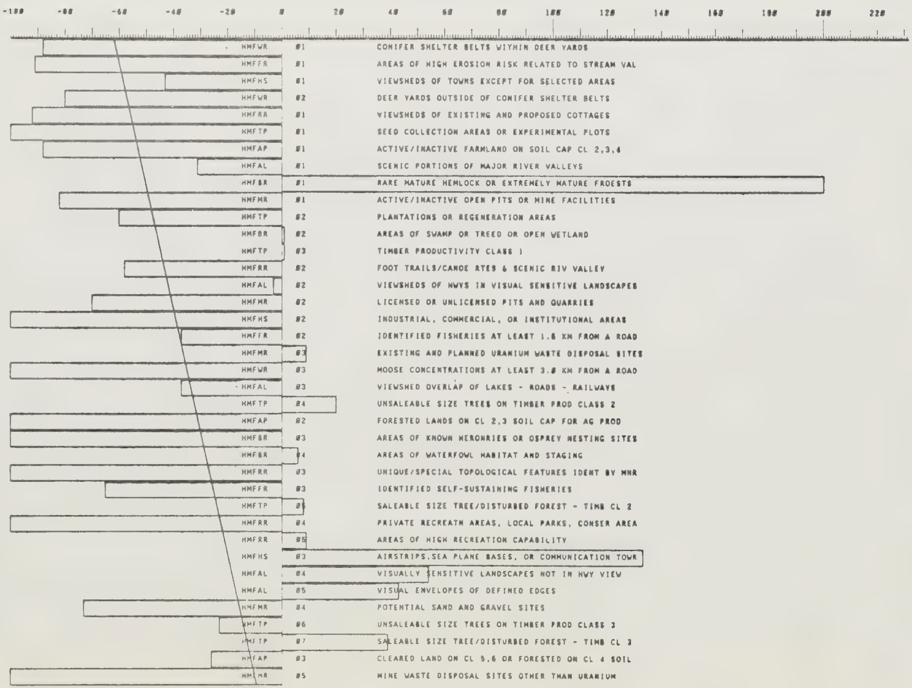
PLOT OF PERCENT DEVIATION OF ESTIMATED AFFECTED AREA FROM EXPECTED AFFECTED AREA BY ATTRIBUTE AND VALUE

DATE :	02-MAR-81	HANMER X MISSISSAGI
SYSTEM CODE :	HMAR3	A ROUTE ALTERNATIVE - CENTRAL TO NORTH
CELL EDGE :	200 METRES	
CONCEPTUAL LENGTH :	210100 METRES	
CONCEPTUAL AREA :	2563 HECTARES	
TOTAL NUMBER CELLS :	3466	
TOTAL AREA :	13864 HECTARES	

X-INTERCEPT :	44.67	X-MEAN :	19.50	SLOPE :	1.30
Y-INTERCEPT :	-61.83	Y-MEAN :	-34.84	EQUATION OF LINE :	Y = 1.30 X -61.83



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CHAIRMAN GROOT: Thanks very much. Any questions?

Q: MR. JOHN KERR (MNR): Leigh, could you tell us what kind of computer your program operates on for converting polygon data to grid cell format?

A: MR. LEIGH HARMESON (Ontario Hydro): We use a PDP 11/70.

Q: MR. JOHN KERR: Will it operate on a PDP 11/50 and is it available to others?

A: MR. LEIGH HARMESON: As far as I know Hydro policy, yes. We have sold programs to other people. I should warn you though, in the routine there may be requirements for modifications as to the way you record your polygons. As you know, in our system every polygon is recorded independently, as opposed to single line segments. I really don't know, but that may cause some problems. It is out of my realm.

Q: NO NAME (off mike): You mentioned that Hydro's present system would not provide alternative routes. Have you thought about developing such a capability?

A: MR. LEIGH HARMESON: We did develop one years ago and subsequently threw it away. There are reasons for this. One is I do not think the public liked it. Another reason is I don't think we, as planners, have a good enough handle on impact assessment to be able to give qualifiable numbers to do this effectively.

CHAIRMAN GROOT: Are there other questions? If not, thank you very much for your presentation. Don't go away. You will be joined by some other speakers. We now will have general questions. I would like to have all the speakers from both yesterday and today up here, so you can face your audience again. Excuse me, there is an urgent announcement by Robert Code.

MR. ROBERT CODE (MNR): It is to talk about a questionnaire that was in the packet of information which was handed out at the beginning of the meeting. As the audience is beginning to dwindle I should like to remark on it before any more people leave. The questionnaire deals primarily with about four items: Digital Maps — your response will help us determine your interest in the course we may follow. The Seminar — we would like to know what you think of it, and whether you think there may be better ways to communicate on this subject of geographical referencing. As to questions which remain unasked following the next session while the speakers are here, or if you have questions that you did not want to ask here or which occur to you subsequently, please send them to us. People have asked me when the proceedings of the Seminar will be available. I think this will be in May or early June. It will be as soon as possible, in any event.

CHAIRMAN GROOT: Ladies and gentlemen, you have now an opportunity to ask questions of any one of the speakers. You have listened patiently and I imagine that you have some very urgent questions, observations, critiques, or the like. Who would like to fire the first one?

QUESTIONS AND ANSWERS

(Following Sessions Held on March 11, 1981)

Q: MR. GARRETT PITTENGER (MNR): I have a question for anyone who would like to answer it. It is with regard to the relationship between the Ontario base maps, air photographs and remote sensing. I ask because I would like to see some means of comparing air photos against the Ontario base maps. Is it possible for those photographs to be tied into the geographical referencing system?

A: MR. JOHN KERR (MNR): If you are referring to the FRI standard air photography at a scale of 1:15 840, no, they are not the same scale as the OBM maps. I understand, however, that the foresters have flown, or are flying Southern Ontario at a scale of 1:10 000 which will match the OBM map scale for Southern Ontario.

With respect to remote sensing, we are considering digitizing some OBM maps in Southeastern Ontario and the Ontario Centre for Remote Sensing has shown an interest in correlating some of the OBM digital data with some of the land use maps they have produced. However, nothing has actually been done in this regard to date.

Q: MR. GARRETT PITTENGER: John, is there any intention perhaps, to issue scale-correct photos with geographic reference points on them, so that there can be some kind of correlation?

A: MR. JOHN KERR: I think Cy Osborne can answer that better than I can but I should add that the Task Force on Geographical Referencing recommended that photo maps be produced for the Hudson and James Bay Lowland areas because it is impractical to plot or digitize the multitude of lakes and streams in those areas, particularly when the drainage boundaries are constantly changing.

A: MR. CY OSBORNE (MNR): Yes, there really is not much to add. I think John has identified the area in which we propose to produce

orthophoto maps. But if your question is directed towards orthophoto mapping for the whole Province, the answer is no. We have no present intention of doing that — there is nothing to stop you doing it.

Q: MR. GARRETT PITTENGER (MNR): But it is not part of the program?

A: MR. CY OSBORNE (MNR): No, not any more.

Q: MR. GARRETT PITTENGER: The only way we would be able to use correlation from one to the other then, is visually or graphically? (Yes)

A: MR. JOHN KERR (MNR): I should have added that the photography which was used for the production of the OBM maps is available. It is, however, at a much smaller scale than the OBM maps themselves.

CHAIRMAN GROOT: Thank you very much. Another question? Yes?

Q: MR. PETER DEWHIRST (R.M. of Ottawa-Carleton): We have been involved in a joint mapping program with the NCC for about ten years and most of our region is mapped. Unfortunately most of the maps are at the wrong scale, in the wrong units and show the wrong grid. (Laughter) We are now producing 1:2000 mapping (the right scale), in the right units (metric), but we do not know about the grid yet. Our maps are also bilingual, so they may not be too bad after all. We are interested in computer graphics since we also do a lot of project mapping. We are very interested in utility mapping because we have to keep track of what is under the road as well as what is on top of it. Eventually we are going to have to ask our politicians for some money, and so my question involves money. I don't know whether I should address it to Ken or John. Anyway, since the OBM is subsidizing the municipalities up to 90%, is there any thought of subsidizing the municipalities who want to go to a computer record system?

CHAIRMAN GROOT: Maybe that should be directed to . . . ?

MR. KEN RICHARDS (Provincial Secretariat for Resources Development): Where is my chauffeur? (Laughter)

CHAIRMAN GROOT: He's sitting right there. (Laughter)

MR. JOHN KERR (MNR): I think maybe Mr. Code could answer that.

A: MR. ROBERT CODE (MNR): John, you should have better thought than that. The answer is NO. (Laughter) It is not considered a product.

Q: MR. PETER DEWHIRST (RMOC): We are going to have to live with that for now. Thank you.

I have another question which perhaps Dr. Linders can answer. Our maps contain 1:500 scale information which we have taken from 1:2500 photographs. If we digitize them and incorporate them in the system, how would this data meld with the 1:2000 and the 1:50 000 information? What we would be concerned about is — would we extract our information at 1 in 500 accuracy or would it be getting all mixed up with the other data?

DR. JAMES LINDERS (University of Guelph): Was the other scale you want to go to 1 in 500?

MR. PETER DEWHIRST: We have 1 in 500 information which we put in. We would digitize manholes and this type of thing.

DR. JAMES LINDERS (University of Guelph): It is utility mapping? (Answer: Yes, utility mapping.) And what is it you want to correlate it with?

Q: MR. PETER DEWHIRST: Well we could extract 1 in 2000 information that is in there, but would we maintain our accuracy or would the 1 in 2000 information filter into the 1 in 500 information?

A: DR. JAMES LINDERS (University of Guelph): Well, I am not the one who should answer that. I think that should be answered by John Kerr because it deals with the accuracy of the map scale. All we have been doing is picking up the product and entering it into the data base, and maintaining or being consistent with the standards we have been given. Now as to the quality of the data, that is a thing that is really outside our domain.

A: MR. JOHN KERR (MNR): There are a lot of chauffeurs out there. (Laughter) The OBM mapping program is producing maps with an intended ground positional accuracy which equates with 1/2000 of the map scale. Thus a map at a scale of 1:2000 should have a ground positional accuracy of one metre. That is, the relative position of features to other features and to the grid shown on a 1:2000 OBM map should be correct to within one metre, on the ground. Although this is more accurate than most 1:2000 mapping it does not provide the level of accuracy you might require for 1:500 mapping. Nevertheless a reasonably accurate 1:1000 scale map could be derived from the OBM 1:2000 scale map. Any thematic data subsequently added to these maps is only as good as the source material from which it came.

Q: CHAIRMAN GROOT: I would like to ask a question of the previous questioner. You said that you had the wrong map scale, the wrong units and the wrong grid. Why do you say that? Wrong with respect to what?

A: MR. PETER DEWHIRST (RMOC): We started mapping at a scale of 1:2500, later we produced some maps at 1:1250, subsequently we just produced photomaps at 1:5000. I was comparing that with the 1 in 2000 and the 1 in 10 000 of the OBM.

Q: CHAIRMAN GROOT: Did the 2500 and the 1 in 1250 serve your purpose? (Answer: Yes) Then why is it the wrong scale?

A: MR. PETER DEWHIRST (RMOC): We were looking at it in the light of joining up with the 1:2000 scale maps being produced by the Province.

Q: MR. CY OSBORNE (MNR): Are you saying that you can't? Are you on a different system or something? Are you on the UTM system?

A: MR. PETER DEWHIRST: We are on the 3^{o} system.

MR. CY OSBORNE: As someone suggested a little earlier, if we've got a little black box between you and me, we can talk to one another.

MR. ROBERT CODE (MNR): Mr. Chairman, I believe the answer to the question you asked Peter — what they have is mapping which is called "consisting of non-conforming use". (Laughter)

MR. JOHN KERR (MNR): Peter, your mapping is not digital right now? (Answer: No) I would like to clear up something. It has been suggested from time to time and repeated here at this Seminar, that existing maps on Lambert Conformal and other diverse projections could be digitized now and put through a transformation routine in order to convert the data on the maps to a UTM base. This is really not practical for two reasons. The first is cost. For example, an average FRI digital map might contain 400,000 coordinate pairs to define the data on it. If each point could be transformed for a cost of two cents, it would cost $8,000 to convert the FRI data on a single map to a UTM base. The second reason transformations are impractical, for this purpose, is that the position of the same features shown on two different maps, covering the same area, often differ more because of the different techniques and photography used to make the two maps, than due to the different projections the maps are on. In other words, if you take an existing digital Lambert Conformal map and pass it through a very accurate transformation and scaling routine to convert it to the same grid and scale as an OBM map you will find the features on the transformed

map will not match those on the OBM map perfectly. The only way this process can work effectively is to start with a common grid or projection, for example the UTM, transform the base map data to whatever projections people are interested in, then after superimposing their themes on the new projections, transform them all back to UTM. It would be much simpler, however, for everyone to just use the UTM grid and the OBM maps in the first place; that is if the OBM maps are available.

CHAIRMAN GROOT: There was another speaker? Yes?

Q: MR. GEORGE LOEWEN (City of St. Catharines): I have a question for Andy Datlen. Most cities the size of my city, St. Catharines — we are about a hundred and twenty thousand — most cities of from 50,000 to say 200,000 have the same problems, only magnified. If it (a system) glitters and it is portable, we would like to buy it rather than invent our own. It seems that you have a system in the City of Toronto — rather the City of Toronto has a system that solves all the problems common to cities about that size, and probably some smaller ones as well. Now the question is: Can this be marketed at all, or do you have a marketing scheme there?

The second question is: How much would it cost? Is there a rough way of estimating the cost of duplicating a file that you have, based on volume, and can it be related to population? In other words, if a smaller city would like to buy some of it, or a system like it, and install it, how much would it cost?

And just as a parting shot; Seeing that one of the government ministries has just bought Mr. Datlen, why couldn't they just buy the proprietary rights to the system (of the City of Toronto) and peddle it to ALL the municipalities and save us ALL some money?

A: MR. ANDY DATLEN (MCCR): To answer the first question, there was no thought of developing the system so that it was saleable, the main reason being that the software itself is only a very small part of the system. The system, known as the Central Property Register, includes a lot of manual administrative and other procedures accompanied by bylaws and funding, which make it work. That in total is the system. If that could be packaged and sold, then maybe. For example, the enforcement of correct municipal addresses has to be in place long before we put in any system based on the municipal address. That is not portable. That is something you have to set up yourself; you have to write the bylaws You have to designate who is to enforce it. That is just one example of a number of procedures that have to be portable together with the software. The software itself is portable, probably to any IBM type main frame computer using MVS as an operating system, with probably a few minor changes. It is all the other stuff that goes with it that probably is not portable.

In answer to the second question which related to cost, never at any time did we go before City Council and say we need $10 million to develop this wonderful thing called the Central Property Register and here are the benefits over the next twenty-five years. That sort of approach usually gets you nowhere. What happened was that each one of the operational files within that system was justified on its own merits and had a sound business reason which paid for its development. For example, the housing inspection file was developed and paid for within one year by automating the process of summons production. There used to be many clerks writing out summonses and issuing them; this was automated. The text processing system was paid for in nine months by avoiding the cost of outside typesetting, the cost of proofreading and re-proofreading and typing. So each one of those components had its own business reason. The only component where we had to go to Council for extra money was the actual digitizing for the property centroids, and that in itself had its own business reason; so all we had to do was to go before Council occasionally for small amounts of money — $30,000 at one time, $45,000 another time, and that is what we did. The rest was buried in the operational systems.

CHAIRMAN GROOT: Supplementary?

Q: MR. GEORGE LOEWEN (City of St. Catharines): Yes! I understand — I think anyone who works for a municipality knows that if you want anything, you do it in small bites. We all do it that way. But it seems to me that you have gone through this — and we also all know John Gall's dictum that you can't build a big system from scratch, you have to start with a little system, and any system that works at all is built from the ground up — but your system seems to have achieved this, at least it appears to have, it certainly looks like it has.

It should be possible, then, to summarize the steps necessary for a municipality to go through. I am assuming that there is a vast similarity between all the functions of most of the municipalities — you may have a few we don't have but, generally, we have water; we have taxation; we have this problem of the multiplicity of addresses and so forth. It should be possible to summarize the steps that you went through and sort of put a cost on the generating of any given unit of a file. You have had that experience, so you should be able to ball-park it. I am just asking, does such a documet _exist_? If it doesn't it should be possible to create this, and then other municipalities could justify it on the same grounds as you already did. They wouldn't have to break new trails. Our councils would believe us because your system is _there_; it is eloquent proof that it _did_ work and it _could_ be done in small steps. Does that make sense?

A: MR. ANDY DATLEN (MCCR): It does make sense. Such a document did not exist when I left, and it was on my list of things to do. I don't know whether it ever will be done now. Even if it were possible to write down the steps which a municipality should follow in putting in a system like that. Those are only the things that can be documented; there are many other things that cannot be documented, such as the informal network of friends that you build up in various departments that will do a few things for you. These, most of the time, have far more of an effect on getting a system in and running than do the things that you write down on paper.

CHAIRMAN GROOT: Roy, do you have a question?

Q: MR. ROY AUDAS (MNR): First of all I would just like to answer Peter's question; he asked about the transfer of information from scale 1 in 500 to a scale of 1 in 2000 or 2500. I am a participating member on one of the committees on the National Digital Standards Committee, and one of the items that we are discussing is map scales — information generally would be scale-related. If I wanted your information and you were working in a scale of 1 to 500, and I was working in a scale of 1 in 2500 or 1 in 2000, I would only require a resolution for my scale. I would not polute your information; I would just get your information and use it for what I wanted. You would not be able to get information from me that would be usable at 1 to 500 because I would only be interested in information in a scale of 1 to 2000. So it is the user who would make that decision and the resolution of the information would really be scale oriented.

The other point I would like to make — and this is for Jim Linders — not a criticism, Jim, just an observation. I understand that you are working on the georeferencing system for John Kerr who has certain priorities. You are also working on the FORMAGAIN system for John Osborn who has his priorities; you are working on the system for Consumer and Commercial Relations for Ray Scott, who has his priorities; you are the head of an active university. How are you organizing these priorities, and do we get any kind of a time frame when you are going to resolve some of these problems? It has been my observation that with research and development in Canada we overdevelop and then buy something off the shelf because it is not usable by the time it is needed, or somebody else has designed it beforehand. Do we have any kind of a time frame when some of these programs will be available?

A: DR. JIM LINDERS (University of Guelph): It is our expectation that the FORMAGAIN system will start to pick up data and start running imminently. In other words, we can collect the data now; we can store it; we can regurgitate it into the level that they want. That is not quite true for OBM, and I suspect this is what you are aiming at. We certainly

haven't built the information structures for the culture, primarily because there were other priorities. For the last while most of the effort has been directed towards FRI. I am not sure where the effort will be directed next year. That is something that is subject to negotiation between the Ministry and myself. Clearly there has been a lot going on and perhaps we have bitten off too much in the sense of trying to keep too many actions going at one time. Again, GEOREF was meant to be a project; it was meant to identify the problems and to show solutions for the problems. Originally it was not intended that this be a final production system. GEOREF was truly intended to be a pilot production system. But it is not the case with FORMAGAIN. It was intended that the people in forestry have a workable system. Now I anticipate there will be some problems with the FORMAGAIN system, but I do not anticipate they will be big problems. I think that everything we have done so far is more or less on stream. There are some things we have not done as well as we should have, but others are somewhat better than we expected. As to where we stand in terms of priorities, again that is something that depends on the Ministry and the level of funding. I am not sure I can answer it any better than that.

Q: DR. J. DUMANSKI (Agriculture Canada): Both a comment and a question. First of all, a lot has been heard during the course of this meeting, having to do with data input, that is whether scanning is superior to hand digitizing. Although we all feel that hand digitizing will ultimately be taken over by scanning, a point of significance is that the two are very similar when compared on the basis of cost of input per line inch according to today's technology. And I suspect that this will remain so in the near future. Consequently if one is deciding which way to follow, the important factors are the amount of maps you have to input and the size of your EDP budget. With scanning you gain time, but you have added budget requirements.

Now the question is directed to the futurists on the Panel: As mapping agencies we have all turned out paper products and continue to do so. However as we move into the area of information utilities, do you foresee a time when we will no longer be turning out paper products, that our information in fact will all be in digital form to be turned out as a particular kind of product only on demand?

CHAIRMAN GROOT: Ruben, do you want to tackle that one?

A: MR. RUBEN NELSON (Square One Management, Limited): I suggested at the beginning of my own talk that predictions are a dime a dozen, nevertheless here is another. I think there will be a substantial diminution in the kind of standardized paper map that we now have. Whether we will ever see the day in which paper products are totally non-standard, in the sense you only print out what it is you want from some kind of system, I do not know. This extreme may be questionable simply because some map uses are so common. And in part, I suppose it depends on what time frame you are looking at. If you are looking at 1990, there are still going to be sheet maps, but by the year 2000 there will be substantially fewer. By the year 2025, who knows? If one looks at the basic orientation, now it is still a graphics orientation with a smaller add-on of non-graphic information. By 1990 that may be kind of half-and-half. By the turn of the millenium, the primary focus I think will be on information housed electronically and then printed out in whatever form one wants it, with only a small slice of standard "mapping products". This may not be very encouraging to those of you who are basically in the sheet mapping business, but I think that is where it is going.

CHAIRMAN GROOT: Thank you. Robert?

Q: MR. ROBERT CODE (MNR): I just want to ask a question. (Laughter) I feel the urge to form a committee. How about that? (Laughter) I would like to ask if George Loewen from the City of St. Catharines would volunteer to chair this committee. Also, I would like to ask for two volunteers from municipalities which may be represented here, or who might be interested to act on this committee which would identify what I think George was talking about, namely a simple generic information system for municipalities. I remember at the R&D meeting on Surveying and Mapping Needs at Ottawa over a year ago, that the Quebec Corporation of Surveyors in its Brief given by Gerrard Raymond suggested the generic system as a candidate R&D subject. Although they were thinking of municipalities in Quebec, I think there is a need for

such in Ontario. If that suggestion, George, is something you feel we could pursue, I would like to give you my assurance that we can be of some help. Do you want to make yourself seen again, George?

A: MR. GEORGE LOEWEN (City of St.Catharines): In order to be seen, all I'd have to do is to stand up, I think I would be visible from the rear. I was tempted to retort, when Bob spoke of the committee, that I was reminded of the animal that was legendarily the product of a committee, and we have probably had enough of those.

But I think if you are talking about something constituted under the auspices of the Ministry of Natural Resources, I can see this; it seems to me you need some leverage. In other words, you cannot create a committee in a vacuum as you can create a common standing committee.

Q: But are you suggesting to constitute something like this under the auspices of the Ministry of Natural Resources?

A: MR. ROBERT CODE (MNR): That is correct.

MR, GEORGE LOEWEN: I would like to talk about it.

MR. ROBERT CODE: We will get together soon? (Yes) Thank you very much.

CHAIRMAN GROOT: It used to be Dear John, with reference to our decision in the corridor. (Laughter) I would like to add one minor thing to this question of paper maps, and non-paper maps and what Ruben said. In my own organization we are phasing out printed products in the geographical names area, not immediately, but over the next four or five years. If you want a printed Gazetteer of Canada you will have to pay a lot of money. It will be available only in microfiche form or computer tape for a few cents, but it is going to be a luxury — it is going to be antique-like, you know. You will pay a lot of money for the printed thing. Jim?

DR. JIM LINDERS (University of Guelph): Can I just make two comments? The first one is with regard to the Raster Scan. I certainly believe the Raster Scan technology can be cost effective for simple graphics, but I think if we are looking at complex graphics, we have a long way to go. I do not think it is going to come about quickly. In order for the utility to really function it is necessary to collect data, and I don't see how we can collect enough data in the next ten years to really make this utility functional unless something happens to accelerate this technology, or to accelerate the data gathering process.

CHAIRMAN GROOT: Thank you. Time is pressing and people have to catch planes and so on, and the last question is to John Kerr.

MR. JOHN KERR (MNR): I wanted to respond to Dr. Dumanski's question about future representation of data. I believe by converting data to digital form we increase the ways it can be displayed. I have seen tabular data which it would take days to assimilate mentally, converted to pictures the information from which can be assimilated in minutes by the human mind. Most of you are familiar with choropleth maps and how valuable they are for rapidly conveying data to people. Maps are the most convenient way of displaying most types of spatial information, however there are many instances where better use could be made of some of the information contained on maps if it were converted to tabular form. For example, the Land Use Coordination Branch in MNR has the requirement to know how many summer resort parcels can be supported in the area covered by specific NTS 1:50 000 scale maps. This type of information cannot be determined simply by looking at the map. Shoreline lengths have to be measured and summed according to classification of the adjacent lands, and lake areas also are computed and summed. Using manual techniques and a pocket calculator this task takes two and one half to three days per map. By digitizing one of these maps we were able to generate a report and provide all the necessary data in the most convenient form in less than a day. The data was all there on the hardcopy map but in a form that was not suitable for providing the answer to a specific type of question. When

in digital form, the data could be manipulated into the most effective medium for human consumption.

With digitization comes versatility and I believe we are going to see a greater variety of ways of displaying data in the future. There will be instances where the map is replaced by reports, pictures and graphs and there will be instances where reports and other forms of data are converted to maps. We will be able to have the data we want in the form most suitable to us.

I also want to say that I agree with the comment on manual digitization. I have seen many digitizing systems, those which appear to be most effective in the production of maps are using manual digitizing techniques.

CHAIRMAN GROOT: Thank you, John. With reference to the geographical names earlier on, the national toponymy data bank has over 150,000 records in the computer now and will contain 350,000 by 1982. We use computer technology to print through Xerox machines — I don't know exactly how it works, but you put a tape in and the book comes out at the other end. We brought down the printing price including the typesetting normally from $28 a copy to $8 a copy, and still we think that is too expensive, in the longer run, so the tape will generate the microfiche in future and that will be sold for 25¢

I would now like to first of all thank you, audience, for your participation, and I would like the people not to go away yet.

Mel Plewes will give some observations about his impressions of the Seminar, make a little wrap-up. Mel is policy advisor of the Provincial Secretariat for Resources Development, and as such is very close to the action of finding resources for developing the systems and to convey to the politicians the need for integration. So Mel, I would like you to come here and give us your impressions.

SUMMARY COMMENTS

MR. MEL PLEWES
PROVINCIAL SECRETARIAT FOR RESOURCES DEVELOPMENT

Thank you, Mr. Chairman. I will try to make my impressions short and I will not summarize as the Programme states. I think the chairmen have summarized the presentations very well.

A conference, like this one, must have been held at least two other times in history. Once perhaps when the Essenes were packing all their scrolls into clay pots before they fled from Palestine under threats from the Romans. Another such meeting probably occurred when a group of friars and abbots assembled in a cloister at the time when the Gutenberg press was first invented, wondering just what they were going to do with their old quill pens, probably speaking in Latin about such things as *posunt qui sciunt* (knowledge is power). I wonder if perhaps we haven't lost this historical perspective in our conversations to date.

What I would propose to do is to review Ruben Nelson's presentation of yesterday, and highlight some of the points which I think ought to have received more attention, rather than dwell on those things which I think have been discussed. Everybody will be able to read the proceedings which will come out very shortly and I commend them to you.

I think all the speakers did a pretty good job in bringing the audience up to date. Out of the eleven presentation, eight were updates, two dealt with future directions and one dealt with the policy perspective. The presentations varied in quality and content. Of the people who are remaining here, could you just raise your hand if you expect to be around in thirteen years? If we are not going to be here, what are we leaving for the people who follow? Is anybody going to be here in thirteen years? Just Bob Code! Who will use the stuff that we have been discussing? What will society be doing in thirteen years? Can anybody conceive of what will be happening? I think these concerns were fundamental to what Ruben Nelson was trying to get across but

the speakers failed to address these concerns, even though they were conscious of bringing us up to date as to what has happened in the last three years.

Ruben Nelson believes ICOGR is a very important group which I think will continue for thirteen years. We have already seen a committee spin off it today, so for certain ICOGR will be around, Bob. (Laughter) Probably the individual members of ICOGR know where they are; they may even know where they are going, but I am not certain that the other clients to whom this information is important know where ICOGR comes from, where it is now or where it is going, and some of them probably do not even care.

We are all conscious of important dicta which constrain our actions, and I thought of one that might be applicable here and that is, if you don't know where you are, and if you don't care where you are, then you ain't lost. There are a lot of people out there who just are not aware that they are lost! You have to get out there — to the agencies — and convince them they are lost. (Laughter) It must be recognized that they are going to continue to gather and transform it into information, and this effort will continue in isolation. It is up to you in the audience to get out there and convince those who are not participating that there are benefits in participating. I think that Ruben Nelson's main point about ICOGR was that the process has to be opened up; it has to involve the others, and I think that is the fundamental challenge that just has to be addressed.

The preparation of land related information will require greater involvement of agencies. There will be more participation demanded if the agencies recognize they are lost or if we can convince them that they are lost. I think the time is right to consider making major changes in the structure of the ICOGR organization.

Getting to Georeferencing, I found the presentations very helpful, because I work in one of the areas, the Ontario Basic Mapping Priorities Group, and I really did not understand just how it all fitted together.

I am very grateful for everybody's elucidation on how I relate to everything. I am not certain I can do anything with that information, but I now know where I am and where I can go.

A number of unanswered questions remain dealing with geographical referencing. I think one important question that remains is the effect of legislation. In the context of all the stresses and forces that are making people realize the value of geographical referencing, and particularly Jim Linders, I liked your notion that geographical referencing is a philosophy. That appealed to me and it could even be considered a religion. (Laughter) That appeals to my sensibilities and if we can only get a symbol to reinforce that religion, we would be all set. But dealing with geographical referencing, I think that one of the stresses that was not identified here, although I think Leigh Harmeson started to get into it at the end of his presentation, is the influence that Environmental Assessment (procedure, process, statute, requirement) exerts, at least in this Province, for some undertakings. These procedures will create a real demand for geographical referencing. No longer will proponents, in my view at least, be able to mask and camouflage difficult issues because they do not have the wherewithal to gather data or information. If the proponents can be convinced that they can plug into a switchboard, put the jack in the right hole, and retrieve meaningful data quickly and at reasonable expense, then the environmental assessment requirements will serve as a positive influence to ensure geographical referencing is implemented.

This brings me to another issue, and that is, the need for back-up staff which was not addressed. Although I do not know what the City of Toronto is going to do without Andy Datlen, I think his leaving results in a real loss to them, a gain for the Province. But it seems to me that one consideration in managing geographical referencing offices is to ensure that back-up staff is available. We have to have back-up systems to be able to ensure continuity. I would hate to see the City of Toronto languish for a period of time until they found somebody to replace Andy. But I think there has to be

some kind of continuity within any implementation system. I do not think we can afford to have more RISC (Regional Information Systems Committee) situations, where data was collected by a provincial agency and some regional municipalities on the understanding the data would be incorporated into a system. Some planning departments made allowances and provisions for using the insights which could be derived from the data and information, but the data was never taken from the hard copy and put onto the system. Somewhere along the line there has to be some enforcing mechanisms developed to ensure that what is agreed upon actually takes place.

Ruben Nelson also noted that it is necessary to understand the current organizational context, you know, how to use it — I'll say how to infiltrate it; he didn't, but I think that was what he was getting at — find the soft spots and exploit them. Bob Code has created an organization with the municipalities this afternoon by developing a sub-committee. I think sub-committees associated with the ICOGR umbrella might be devices to ensure that the message is distributed to the far corners of Ontario.

We in the Provincial Secretariat for Resources Development, which Ken Richards addressed this morning, try to look at priorities in planning and how to assess them. It was noted that some of the insights derived suffer from lack of information but they are still translated into policies. I can assure you that the policy formulation process is not going to stop while new data and information is gathered and new systems are developed. And you are going to have to make allowances and develop some sort of incremental approach to ensure that the world that you capture, the picture of the world that you capture, is the real world. And the translation of that to the politicians or these "phantom users" that we have not identified as yet, is a very important task.

While _I_ was thankful for the Dineley lunch, I know because we have 256 people here, a great number from outside the Province, that they probably won't be back if you have it here, Bob. (Laughter) But

the coffee was hot and it was delivered on time. Except for one case where the hydro went off, things went along without a hitch and I think that is an indication that you had good chairmen, who had good control over their assorted groups. Laura Ives and Dick Groot did a superb job. I think Bob Code should be congratulated for his foresight and his courage in inviting an outsider like Ruben Nelson to review a program as contentious and as fuzzy as geographical referencing is. I think also, if Ruben Nelson did not tell you he told me, that he served some other purposes too and that is to commence the development of a network, perhaps an informal network, but at least it has been flowing through Ruben to other parts of the Dominion.

John Kerr organized a good conference. It was topical, but next time I think "Future Directions" ought to take a higher profile. If you can get the proceedings out on time this year, I think you will get some good feedback. To the people in the audience, I wish to remind you to fill out those questionnaires, identify the questions or problems which you have so that John Kerr can do something about it the next time around.

In conclusion, I have learned a number of things from working with engineers and systems designers and so forth. The critical things that I have learned are characterized in three parts: An engineering notion that a triangle is really the strongest structure; we have seen triangles here in organizational charts and even though Ruben Nelson tells us we are going to have distributed networks, still there is going to be that old triangular hierarchy, and it is a very strong structure; another thing I have learned is that water always runs downhill, and that is a physical law and I do not think it has been refuted at the Seminar here; and, the other thing was that you really can't push on a rope. And I think that our challenge now is to get out there, take the "rope" of people who do not even know they are lost and start tugging on it to bring them into the fold and show them the benefits of geographical referencing. (Applause)

CHAIRMAN GROOT: Thank you very much, Mel — a first-class resume of a good conference. I personally want to thank the speakers of today, thank Bob Code for inviting me to chair this session, and to thank

you for your participation. Bob Code has indicated he wants to say a few final words before we all rush off. Robert.

MR. ROBERT CODE (MNR): They are very brief, and it is a pleasure to have to speak them and it is towards extending thanks. I would like to thank all the delegates who attended, and to those who especially related their experiences. There are the people from around the country, Michel Paradis, Quebec; Kent Meisner from Alberta; Terry Fisher, Saskatchewan; Dave Crandall, Manitoba, and many, many others. I would like to speak to the work done by the speakers who made presentations today. It has been a time-consuming effort on their part, and it is appreciated by everyone. A special word of thanks too, to the Chairmen for each day, and the people who really ran the meetings — Laura Ives from Hydro, and Richard Groot from Energy, Mines and Resources. That concludes my remarks and on behalf of the Committee, I wish to thank you all. The end of the session. (Applause)

APPENDIX A

AGENDA

INTERMINISTERIAL COMMITTEE ON GEOGRAPHICAL REFERENCING (ICOGR)

PROGRAMME

TUESDAY March 10th

Chairman, *Laura Ives*
Ontario Hydro.

8:30 – Registration.	
9.00 – Official Opening.	– *Robert G. Code, Chairman, Interministerial Committee on Geographical Referencing.*
9:05 – Theme Speakers.	– *Hon. James A.C Auld, Minister of Natural Resources* – *Robert G Code. Chairman. Interministerial Committee on Geographical Referencing.*
9.35 – Future Directions for Georeferencing	– *Ruben F W. Nelson, President, Square One Management Ltd.*
10:30 – Coffee	
10:45 – Update on the Ontario Basic Mapping Program	– *Cyril T. Osborne Ministry of Natural Resources.*
11:15 – Activities of the National Digital Mapping Standards Committee	– *John H. Kerr Ministry of Natural Resources*
11:45 – Buffet Lunch	
13:00 – GEOREF System Development Update	– *Dr James Linders University of Guelph.* – *John H. Kerr Ministry of Natural Resources*
14.30 – Coffee	
14.45 – FORMAGAIN (Forest Management Agreement Area Information System)	– *John Osborn Ministry of Natural Resources.*
15:30 – Question Period	
16:00 – Adjournment	

WEDNESDAY March 11th

Chairman, *Richard Groot*
Energy, Mines and Resources, Canada.

9.00 – The Needs of Provincial Government Policy Makers Pertinent to Geographical Referencing.	– *Ken Richards Provincial Secretariat for Resources Development*
9:30 – The Need of Municipal Governments for a Geographical Referencing System.	– *Andy Datlan City of Toronto.*
10.00 – Coffee.	
10:20 – Toward the Design and Development of a Comprehensive Geographical Referencing Data Base for Ontario.	– *Dr. James Linders University of Guelph*
11:00 – Discussion period on the need for a Comprehensive Geographical Referencing Data Base and Digital Maps.	
12.00 – Buffet Lunch.	
13:00 – The Provincial Horizontal Control Survey Data Bank	– *Zul Gulamhusein Ministry of Natural Resources*
13:30 – Land Registration Improvement Project.	– *Ray Scott Ministry of Consumer and Commercial Relations*
14:00 – Update on the Ontario Hydro's Computer Assisted Route and Site Selection System.	– *Leigh Harmeson Ontario Hydro*
14:30 – Coffee.	
14:50 – Open Forum – All Speakers on hand for questions from the floor.	
15:30 – Summary Comments.	– *Mel Plewes Provincial Secretariat for Resources Development*
15:45 – Conclusion of Seminar	

QUESTIONNAIRE

The following questionnaire was distributed to delegates at the Seminar held March 10th and 11th, 1981. Twenty-eight responses were received. The results of these responses are indicated by the figures shown in the brackets opposite each question.

Does your organization:

		Yes	No
1. Utilize maps in the 1:2000-1:20 000 scale range?		(20)	(6)
2. Currently utilize Ontario Basic Maps (OBM)?	1:2000	(2)	(17)
	1:10 000	(8)	(15)
	1:20 000	(8)	(15)
3. Expect to utilize OBM when available?		(21)	(2)
4. Now use digital maps?		(6)	(20)
5. Produce digital maps?		(4)	(22)

OBM digital maps could be produced in two forms — graphic digital and geographically referenced (georef) digital. If available would your organization utilize:

	Yes	No
6. OBM graphic digital?	(17)	(4)
7. OBM georef digital?	(20)	(2)
8. Do you foresee in the next five years a need in your organization for digital (georeferenced) OBM maps?	(19)	(5)
9. If response to (6), (7) or (8) is YES, do you think your organization would be willing to contribute to the cost of their production?	(10)	(6)

10. If response to (9) is YES, what do you believe the digital map will be worth to your organization per sheet:

    $1.00 to $10.00 (4); $10.00 to $25.00 ( );
    $25.00 to $50.00 (2); $50.00 to $100.00 (3).

	Yes	No
11. Does your organization currently utilize any positionally related data in digital form?	(14)	(10)

12. Please check the number on the appropriate scale of 1 to 10 which, in your opinion, best describes the Seminar as far as:

(a) Providing an up-to-date review of the status of Geographical Referencing in Ontario;

(b) Being of interest to you and your organization;

(c) Answering pertinent questions of concern to you;

(d) Quality of presentations.

RESULTS:

Scores	(a)	(b)	(c)	(d)
1 (low)	0	0	0	1
2	0	0	0	0
3	0	0	0	0
4	2	0	2	0
5	0	0	4	0
6	1	0	2	1
7	2	2	6	4
8	4	12	7	6
9	6	2	3	12
10 (high)	10	8	1	2

13. The following are questions submitted by delegates subsequent to the Seminar in response to Question 13 "If you have specific questions related to geographical referencing which you feel were not answered at the Seminar, please state them here and we will attempt to answer them by mail, or in the published proceedings of the Seminar".

Q (1): Would you explain what is meant by Graphic Digital Map and Georef Digital Map?

A: A Graphic digital map is one in which the use of the digital data is limited to being displayed on a graphics screen or plotted by an automatic plotting device. Scales can be changed and customized software can be written to extract pertinent characteristics of the digitized graphics. Customized maps can be produced to the extent that those features which have been uniquely coded can be plotted on demand or in combination with any other uniquely coded features. While textual data can be added to features, there is generally little or no intelligence associated with either the linear or textual data. Graphic digital maps generally cannot subsequently be used by others who wish to merge their digital thematic data with the digital base map unless the same system (hardware and software) is used by the thematic mapper as was used in the production of the original digital graphic map. Generally the digital data in a graphics system is associated with a file which is usually limited to a single map sheet. Thus in order to extract anything from the file, the map sheet name or number must be known.

13. (continued):

Since the data is associated with a map file rather than true earth position, windowing across map sheets to extract data using geographically referenced coordinates is rarely possible.

Some graphics systems have evolved considerably and it is becoming more difficult to determine if they are graphic or georef systems without making a detailed examination of the system. However, one capability that generally separates the two is the level at which the system can be interogated. For example, if a system has a generalized query capability whereby information associated with a theme or themes can be derived using geographic coordinates to define the area of search, and a search can extend across several map sheets, it is in all probability a georef system. Georef digital maps have all the capabilities of the graphic digital map as well as the potential for many more. Because relationships between certain features must be maintained, the procedures by which the data is captured in a georef system are more complex than in a graphic system. For example, a georef system will often contain information about the features lying on both sides of a common shared boundary. A graphics system on the other hand will not unless subsequent digitizing and coding has been carried out in order to link specific information with a specific line segment. Information is generally captured in layers with graphic systems and the different layers may be overlapped to provide a view of the information required. The problem is that if different agencies are creating the different layers they have to use the same system (hardware/software/operating system) if the data is to be merged.

Mr. Andy Datlen's presentation (MCCR) included some further information on this matter.

Q (2): What standards and guidelines were given to Dr. Linders for digitizing OBM maps? (e.g. Scale, accuracy or tolerance, geographical information, property lines, pavement lines,etc.)

A: ICOGR and MNR prepared generalized specifications for the development of a pilot system for the production of digital OBM maps and specific thematic maps. These specifications were included in the contract MNR had with the University of Guelph. A Steering Committee made up of representatives from each of the five applications associated with the contract met monthly at the University of Guelph to ensure what was being developed was in line with their requirements. The standards for the OBM maps were provided by B. Jackson and R. Audas, both from MNR. Some were documented, others were derived through consensus. Included in the documented standards were a booklet on the OBM features, their symbology, line widths, etc., as well as sample OBM finished maps. The OBM data was to be manually digitized from the stereocompilation manuscripts.

13. (continued):

It was anticipated that this procedure would maintain the same level of precision as is achieved by the present method of production which involves hand scribing the OBM stereo-compilation manuscripts. The OBM stereocompilation manuscripts provided to Dr. Linders were at three different scales: 1:2000, 1:10 000 and 1:20 000. All of the features contained on the OBM manuscripts were to be digitized. A table of the relationships between features which we wanted maintained was derived in concert with Dr. Linders, with input mostly from MNR representatives. During the progress of the development input as to other requirements was provided on an informal basis. With respect to property lines, a parcel mapping application was carried out for the Ministry of Consumer and Commercial Relations. The requirements of this project grew as development proceeded until Dr. Linders curtailed its development due to the lack of resources available to continue it. Basically the project called for the digitization of parcel boundaries from existing subdivision plans and the subsequent merging of these boundaries with the OBM map detail. Relationships were to be maintained between adjacent properties and an editing facility to permit adding, deleting and amending of features was required. Also required was the capability to plot lot corners by inputting coordinate values where such values were known. The township fabric was to be captured in a hierarchical fashion, for example first by township, then concessions, followed by individual lots. In this way data could be associated with the entire township, the concession or the individual township lot in which it was located and accessed accordingly.

Dr. Linders was also made aware of many of the potential types of queries that might be asked of such a system. This was to ensure his design of the data collection procedures would permit the data to be structured in a way that subsequent interogations could be made on the system once the data base had been produced and a generalized query made available. This latter phase has not yet been contracted.

A copy of the specifications accompanying the contract between the Ministry and the University of Guelph is available at Room 6601 Whitney Block, Queen's Park, for anyone wishing to peruse them.

Q (3): Are the dates shown on the colour-coded map displayed at the Seminar, showing the OBM mapping schedules, firm and are the completion dates in reference to digital map sheets or digitized stored data on tape?

A: The scheduling of OBM projects is determined by a mapping priorities committee comprising delegates from all interested ministries. The mapping schedule is based on the priorities defined by that committee and are subject to change only by the committee or when budget cuts delay the program. In any event the

13. (continued):

completion dates shown are for traditional hard copy maps. The Ministry is not yet committed to digital mapping. There are still several basic capabilities which have to be developed or proven before the decision can be made to digitize the OBM maps.

Q (4): Is there and/or will there be a standard digital map covering the entire Province? If so, will there be utility software systems to interface with it?

A: The Ministry has recognized the demand for a provincial map in digital form which can be used by those who require a single small scale map of Ontario for displaying their information. The production of such a digital map containing only the major topographical and cultural features is scheduled for 1982-83. The intention is to also provide a capability for keyboard input of coordinate values of point information in order to permit the plotting of customized symbols at required points relative to the map grid. It is anticipated other utility programs associated with a provincial digital map will be developed as the needs are identified.

Q (5): Are there utility routines available for conversion of locational data from Lambert Conformal to UTM and are these available on line through Queen's Park Computing Branch?

A: Yes, these routines are available but not through Queen's Park Computing Centre. Copies of the routines to convert Lambert Conformal to geographics and then to UTM and to convert UTM to geographics and then to Lambert Conformal can be acquired from Dr. F. Raymond at the Ontario Forest Research Centre, Maple, Ontario, L0J 1E0; telephone 832-2761. The Mathematical Adjustment Unit of the Geographical Referencing Section of MNR has routines for conversions between geographics, UTM and 3° MTM. These can be acquired from John Kerr, Room 6601 Whitney Block, Queen's Park - telephone 965-4538. The latter do operate on the Queen's Park system.

Q (6): Why isn't ICOGR or one of its member ministries studying the information systems which are available (turnkey or adaptive, map oriented, or not) with a view to making a standard package available to municipalities?

A: Several members of ICOGR do in fact attempt to keep abreast of the technological developments in geographically related information systems. However their interests are aligned with their own projects rather than meeting the whole range of needs of municipalities. You will recollect Mr. Code initiated at the Seminar the formation of a committee which would in fact look into the needs of municipalities and identify a simple generic information system which might meet those needs. As a result of this recommendation some direct action is being taken in this regard.

13.(continued):

Q (7): Is anything being done by those involved in geographical referencing and computer mapping to encourage the Ministry of Government Services, Queen's Park Computing Branch, to:

(a) Purchase and support plotting hardware and interactive graphics systems?

(b) Support VTAM upgrade and overall implementation of this software at Queen's Park Computing Branch for all clients?

(c) Encourage CCSD to implement GDDM for graphics and digital data handling on line to Queen's Park Computing Branch?

(d) Provide networking between all computer centres of CCSD to start with and subsequently to all larger geographical referencing and graphic systems?

A: (a) Not to our knowledge. Most applications which require plotting hardware or interactive graphic systems and can justify the purchase of the equipment do so on their own often, however, with advice from the Ministry of Government Services.

(b) VTAM (Virtual Telecommuncation Access Method) permits the use of multiple applications on a single terminal. Currently the QPCC is in the process of implementing VTAM across its entire user base but it is a low priority item due to the small demand for it and therefore will not be operational for some time.

(c) The Communication and Computer Services Division (CCSD) of MGS has had little if any requests for GDDM. There has been some interest shown, however, in IBM's graphic package (DFIS) Distribution Facilities Information System. A demonstration by IBM of DFIS can be arranged through QPCC. Providing sufficient demand for this graphics package exists QPCC will respond accordingly.

(d) The CCSD of MGS has a task force currently working on a province-wide data network for Ontario. A pilot study will be undertaken in a year or so to determine the feasibility of such a network system. The project is currently in the planning stage, implementation however is some time away as the technology required is not yet all there.

13. (continued):

Q (8): I believe that the time has come for ICOGR to both expand its horizons and change the environment within which it operates. It is obvious from the Seminar that municipalities are keenly interested but not knowledgeable about what is happening within the Provincial Government in the area of geographical referencing. Many municipalities are beginning to become aware of their needs in this area and the benefits which might accrue. They are most certainly looking for guidance and help. It is time for ICOGR to interact on a formal basis with this segment.

I also believe it is now essential that ICOGR be seen as an interministerial committee in order to convince municipalities that the Provincial Government is formulating a policy for land information systems. This aim might be accomplished by involving policy makers more directly on the committee and by having ICOGR report directly to Management Board or Resource Justice Policy Field. It should be made clear that ICOGR is not just another MNR committee.

I also feel that ICOGR should begin to explore the possibility of expanding its activities through meetings or workshops which would deal in depth with specific technical aspects of georeferencing and the relationships between particular municipal mapping programs and the Provincial Land Information systems.

In light of this,

(a) Is it possible to have more input from municipalities in the design of the Guelph system? and

(b) Should the file manager be further generalized to enable it to handle the problems inherent in capturing the data for the property layer and utilities?

A: (a) Yes, and this could be accomplished by way of the committee Mr. Code suggested be formed to look into the needs of the municipalities.

(b) Yes, it should but first an assessment of the file manager is in order to ensure it can do effectively some of the more basic things it was designed for. The intention is to prove the technology can or cannot do what we have already defined. If it can, we will implement the file manager and extend its capabilities as the demand arises.

14. Would you prefer mini-seminars or workshops that attempt to focus on more specialized interest areas of geographical referencing rather than a more generalized seminar such as this one?

    RESULTS: Yes (18) No (9)

15. In response to this item the Ministry received several suggestions for improving the contents of the booklet entitled "The Ontario Geographical Referencing Grid". Some of the suggestions have been incorporated and we thank those delegates who responded, for their input.